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CONTENTS.

The Reflex Arc Concept in Psychology: JOHN DEWEY, 357.

Studies from the Psychological Laboratory of the University of Chicago: *III. The Organic Effects of Agreeable and Disagreeable Stimuli*: JAMES ROWLAND ANGELL and SIDNEY F. MCLENNAN, 371. *IV. Simultaneous Sense Stimulation*: AMY TANNER and KATE ANDERSON, 378.

Some Remarks upon Apperception: J. KODIS, 384.

Types of Imagination: RAY H. STETSON, 398.

On Individual Sensibility to Pain: HARALD GRIFFING, 412.

The Third Year at the Yale Laboratory: E. W. SCRIPTURE, 416.

Discussion and Reports:

A Psychological Interpretation of Certain Doctrines of Formal Logic: ALFRED H. LLOYD, 432. *Community of Ideas of Men and Women*: MARY WHITON CALKINS; JOSEPH JASTROW, 436.

Psychological Literature:

Sully's Studies of Childhood: WM. L. BRYAN, 432. *McLellan and Dewey's Psychology of Number*: ALEXANDER ZEWET, 434. *Romanes' Darwin and after Darwin, Cope's Factors of Organic Evolution*: J. MCKEEN CATTELL, 437. *Tyler's Whence and Whither of Man*: WARNER FITE, 443. *Mosso's Fear*: HERBERT NICHOLS, 445. *Haddon's Evolution in Art*: H. R. MARSHALL, 447. *Miller's Inductive Logic*: JAMES H. HYSLOP, 448. *Vision and Galvanotropism*: C. LADD FRANKLIN, WILFRED LAY, 450. *Pathological*: H. N. GARDINER, FRIEDRICH KIESOW, 454. *Experimental*: H. C. WARREN, J. P. HYLAN, 456. *Epistemology*: GUY TAWNEY, H. C. WARREN, E. A. SINGER, 459.

New Books, 466; *Notes*, 467.

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THE PSYCHOLOGICAL REVIEW.

THE REFLEX ARC CONCEPT IN PSYCHOLOGY.

BY PROFESSOR JOHN DEWEY,

University of Chicago.

That the greater demand for a unifying principle and controlling working hypothesis in psychology should come at just the time when all generalizations and classifications are most questioned and questionable is natural enough. It is the very cumulation of discrete facts creating the demand for unification that also breaks down previous lines of classification. The material is too great in mass and too varied in style to fit into existing pigeon-holes, and the cabinets of science break of their own dead weight. The idea of the reflex arc has upon the whole come nearer to meeting this demand for a general working hypothesis than any other single concept. It being admitted that the sensori-motor apparatus represents both the unit of nerve structure and the type of nerve function, the image of this relationship passed over into psychology, and became an organizing principle to hold together the multiplicity of fact.

In criticising this conception it is not intended to make a plea for the principles of explanation and classification which the reflex arc idea has replaced; but, on the contrary, to urge that they are not sufficiently displaced, and that in the idea of the sensori-motor circuit, conceptions of the nature of sensation and of action derived from the nominally displaced psychology are still in control.

The older dualism between sensation and idea is repeated in the current dualism of peripheral and central structures and functions; the older dualism of body and soul finds a distinct

echo in the current dualism of stimulus and response. Instead of interpreting the character of sensation, idea and action from their place and function in the sensori-motor circuit, we still incline to interpret the latter from our preconceived and preformulated ideas of rigid distinctions between sensations, thoughts and acts. The sensory stimulus is one thing, the central activity, standing for the idea, is another thing, and the motor discharge, standing for the act proper, is a third. As a result, the reflex arc is not a comprehensive, or organic unity, but a patchwork of disjointed parts, a mechanical conjunction of unallied processes. What is needed is that the principle underlying the idea of the reflex arc as the fundamental psychical unity shall react into and determine the values of its constitutive factors. More specifically, what is wanted is that sensory stimulus, central connections and motor responses shall be viewed, not as separate and complete entities in themselves, but as divisions of labor, functioning factors, within the single concrete whole, now designated the reflex arc.

What is the reality so designated? What shall we term that which is not sensation-followed-by-idea-followed-by-movement, but which is primary; which is, as it were, the psychical organism of which sensation, idea and movement are the chief organs? Stated on the physiological side, this reality may most conveniently be termed coördination. This is the essence of the facts held together by and subsumed under the reflex arc concept. Let us take, for our example, the familiar child-candle instance. (James, Psychology, Vol. I, p. 25.) The ordinary interpretation would say the sensation of light is a stimulus to the grasping as a response, the burn resulting is a stimulus to withdrawing the hand as response and so on. There is, of course, no doubt that is a rough practical way of representing the process. But when we ask for its psychological adequacy, the case is quite different. Upon analysis, we find that we begin not with a sensory stimulus, but with a sensori-motor coördination, the optical-ocular, and that in a certain sense it is the movement which is primary, and the sensation which is secondary, the movement of body, head and eye muscles determining the quality of what is experienced. In other words, the real beginning is

with the act of seeing; it is looking, and not a sensation of light. The sensory quale gives the value of the act, just as the movement furnishes its mechanism and control, but both sensation and movement lie inside, not outside the act.

Now if this act, the seeing, stimulates another act, the reaching, it is because both of these acts fall within a larger coördination; because seeing and grasping have been so often bound together to reinforce each other, to help each other out, that each may be considered practically a subordinate member of a bigger coördination. More specifically, the ability of the hand to do its work will depend, either directly or indirectly, upon its control, as well as its stimulation, by the act of vision. If the sight did not inhibit as well as excite the reaching, the latter would be purely indeterminate, it would be for anything or nothing, not for the particular object seen. The reaching, in turn, must both stimulate and control the seeing. The eye must be kept upon the candle if the arm is to do its work; let it wander and the arm takes up another task. In other words, we now have an enlarged and transformed coördination; the act is seeing no less than before, but it is now seeing-for-reaching purposes. There is still a sensori-motor circuit, one with more content or value, not a substitution of a motor response for a sensory stimulus.[1]

Now take the affairs at its next stage, that in which the child gets burned. It is hardly necessary to point out again that this is also a sensori-motor coördination and not a mere sensation. It is worth while, however, to note especially the fact that it is simply the completion, or fulfillment, of the previous eye-arm-hand coördination and not an entirely new occurrence. Only because the heat-pain quale enters into the same circuit of experience with the optical-ocular and muscular quales, does the child learn from the experience and get the ability to avoid the experience in the future.

More technically stated, the so-called response is not merely *to* the stimulus; it is *into* it. The burn is the original seeing,

[1] See THE PSYCHOLOGICAL REVIEW for May, 1896, p. 253, for an excellent statement and illustration, by Messrs. Angell and Moore, of this mutuality of stimulation.

the original optical-ocular experience enlarged and transformed in its value. It is no longer mere seeing; it is seeing-of-a light-that-means-pain-when-contact-occurs. The ordinary reflex arc theory proceeds upon the more or less tacit assumption that the outcome of the response is a totally new experience; that it is, say, the substitution of a burn sensation for a light sensation through the intervention of motion. The fact is that the sole meaning of the intervening movement is to maintain, reinforce or transform (as the case may be) the original quale; that we do not have the replacing of one sort of experience by another, but the development (or as it seems convenient to term it) the mediation of an experience. The seeing, in a word, remains to control the reaching, and is, in turn, interpreted by the burning.[1]

The discusssion up to this point may be summarized by saying that the reflex arc idea, as commonly employed, is defective in that it assumes sensory stimulus and motor response as distinct psychical existences, while in reality they are always inside a coördination and have their significance purely from the part played in maintaining or reconstituting the coördination; and (secondly) in assuming that the quale of experience which precedes the 'motor' phase and that which succeeds it are two different states, instead of the last being always the first reconstituted, the motor phase coming in only for the sake of such mediation. The result is that the reflex arc idea leaves us with a disjointed psychology, whether viewed from the standpoint of development in the individual or in the race, or from that of the analysis of the mature consciousness. As to the former, in its failure to see that the arc of which it talks is virtually a circuit, a continual reconstitution, it breaks continuity and leaves us nothing but a series of jerks, the origin of each jerk to be sought outside the process of experience itself, in either an external pressure of 'environment,' or else in an unaccountable spontaneous variation from within the 'soul' or the 'organism.'[2] As to the latter, failing to see the unity of activity,

[1] See, for a further statement of mediation, my *Syllabus of Ethics*, p. 15.

[2] It is not too much to say that the whole controversy in biology regarding the source of variation, represented by Weismann and Spencer respectively,

no matter how much it may prate of unity, it still leaves us with sensation or peripheral stimulus; idea, or central process (the equivalent of attention); and motor response, or act, as three disconnected existences, having to be somehow adjusted to each other, whether through the intervention of an extra-experimental soul, or by mechanical push and pull.

Before proceeding to a consideration of the general meaning for psychology of the summary, it may be well to give another descriptive analysis, as the value of the statement depends entirely upon the universality of its range of application. For such an instance we may conveniently take Baldwin's analysis of the reactive consciousness. In this there are, he says (Feeling and Will, p. 60), "three elements corresponding to the three elements of the nervous arc. First, the receiving consciousness, the stimulus—say a loud, unexpected sound; second, the attention involuntarily drawn, the registering element; and, third, the muscular reaction following upon the sound—say flight from fancied danger." Now, in the first place, such an analysis is incomplete; it ignores the status prior to hearing the sound. Of course, if this status is irrelevant to what happens afterwards, such ignoring is quite legitimate. But is it irrelevant either to the quantity or the quality of the stimulus?

If one is reading a book, if one is hunting, if one is watching in a dark place on a lonely night, if one is performing a chemical experiment, in each case, the noise has a very different psychical value; it is a different experience. In any case, what proceeds the 'stimulus' is a whole act, a sensori-motor coördination. What is more to the point, the 'stimulus' emerges out of this coördination; it is born from it as its matrix; it represents as it were an escape from it. I might here fall back upon authority, and refer to the widely accepted sensation continuum theory, according to which the sound cannot be absolutely *ex abrupto* from the outside, but is simply a shifting

arises from beginning with stimulus or response instead of with the coördination with reference to which stimulus and response are functional divisions of labor. The same may be said, on the psychological side, of the controversy between the Wundtian 'apperceptionists' and their opponents. Each has a *disjectum membrum* of the same organic whole, whichever is selected being an arbitrary matter of personal taste.

of focus of emphasis, a redistribution of tensions within the former act; and declare that unless the sound activity had been present to some extent in the prior coördination, it would be impossible for it now to come to prominence in consciousness. And such a reference would be only an amplification of what has already been said concerning the way in which the prior activity influences the value of the sound sensation. Or, we might point to cases of hypnotism, mono-ideaism and absent-mindedness, like that of Archimedes, as evidences that if the previous coördination is such as rigidly to lock the door, the auditory disturbance will knock in vain for admission to consciousness. Or, to speak more truly in the metaphor, the auditory activity must already have one foot over the threshold, if it is ever to gain admittance.

But it will be more satisfactory, probably, to refer to the biological side of the case, and point out that as the ear activity has been evolved on account of the advantage gained by the whole organism, it must stand in the strictest histological and physiological connection with the eye, or hand, or leg, or whatever other organ has been the overt center of action. It is absolutely impossible to think of the eye center as monopolizing consciousness and the ear apparatus as wholly quiescent. What happens is a certain relative prominence and subsidence as between the various organs which maintain the organic equilibrium.

Furthermore, the sound is not a mere stimulus, or mere sensation; it again is an act, that of hearing. The muscular response is involved in this as well as sensory stimulus; that is, there is a certain definite set of the motor apparatus involved in hearing just as much as there is in subsequent running away. The movement and posture of the head, the tension of the ear muscles, are required for the 'reception' of the sound. It is just as true to say that the sensation of sound arises from a motor response as that the running away is a response to the sound. This may be brought out by reference to the fact that Professor Baldwin, in the passage quoted, has inverted the real order as between his first and second elements. We do not have first a sound and then activity

of attention, unless sound is taken as mere nervous shock or physical event, not as conscious value. The conscious sensation of sound depends upon the motor response having already taken place; or, in terms of the previous statement (if stimulus is used as a conscious fact, and not as a mere physical event) it is the motor response or attention which constitutes that, which finally becomes the stimulus to another act. Once more, the final 'element,' the running away, is not merely motor, but is sensori-motor, having its sensory value and its muscular mechanism. It is also a coördination. And, finally, this sensori-motor coördination is not a new act, supervening upon what preceded. Just as the 'response' is necessary to constitute the stimulus, to determine it as sound and as this kind of sound, of wild beast or robber, so the sound experience must persist as a value in the running, to keep it up, to control it. The motor reaction involved in the running is, once more, into, not merely to, the sound. It occurs to change the sound, to get rid of it. The resulting quale, whatever it may be, has its meaning wholly determined by reference to the hearing of the sound. It is that experience mediated.[1] What we have is a circuit, not an arc or broken segment of a circle. This circuit is more truly termed organic than reflex, because the motor response determines the stimulus, just as truly as sensory stimulus determines movement. Indeed, the movement is only for the sake of determining the stimulus, of fixing what kind of a stimulus it is, of interpreting it.

I hope it will not appear that I am introducing needless refinements and distinctions into what, it may be urged, is after all an undoubted fact, that movement as response follows sensation as stimulus. It is not a question of making the account of the process more complicated, though it is always wise to be-

[1] In other words, every reaction is of the same type as that which Professor Baldwin ascribes to imitation alone, viz., circular. Imitation is simply that particular form of the circuit in which the 'response' lends itself to comparatively unchanged maintainance of the prior experience. I say comparatively unchanged, for as far as this maintainance means additional control over the experience, it is being psychically changed, becoming more distinct. It is safe to suppose, moreover, that the 'repetition' is kept up only so long as this growth or mediation goes on. There is the new-in-the-old, if it is only the new sense of power.

ware of that false simplicity which is reached by leaving out of account a large part of the problem. It is a question of finding out what stimulus or sensation, what movement and response mean; a question of seeing that they mean distinctions of flexible function only, not of fixed existence; that one and the same occurrence plays either or both parts, according to the shift of interest; and that because of this functional distinction and relationship, the supposed problem of the adjustment of one to the other, whether by superior force in the stimulus or an agency *ad hoc* in the center or the soul, is a purely self-created problem.

We may see the disjointed character of the present theory, by calling to mind that it is impossible to apply the phrase 'sensori-motor' to the occurrence as a simple phrase of description; it has validity only as a term of interpretation, only, that is, as defining various functions exercised. In terms of description, the whole process may be sensory or it may be motor, but it cannot be sensori-motor. The 'stimulus,' the excitation of the nerve ending and of the sensory nerve, the central change, are just as much, or just as little, motion as the events taking place in the motor nerve and the muscles. It is one uninterrupted, continuous redistribution of mass in motion. And there is nothing in the process, from the standpoint of description, which entitles us to call this reflex. It is redistribution pure and simple; as much so as the burning of a log, or the falling of a house or the movement of the wind. In the physical process, as physical, there is nothing which can be set off as stimulus, nothing which reacts, nothing which is response. There is just a change in the system of tensions.

The same sort of thing is true when we describe the process purely from the psychical side. It is now all sensation, all sensory quale; the motion, as psychically described, is just as much sensation as is sound or light or burn. Take the withdrawing of the hand from the candle flame as example. What we have is a certain visual-heat-pain-muscular-quale, transformed into another visual-touch-muscular-quale—the flame now being visible only at a distance, or not at all, the touch sensation being altered, etc. If we symbolize the original visual quale by v,

the temperature by h, the accompanying muscular sensation by m, the whole experience may be stated as vhm-vh*m-vhm'*; *m* being the quale of withdrawing, *m'* the sense of the status after the withdrawal. The motion is not a certain kind of existence; it is a sort of sensory experience interpreted, just as is candle flame, or burn from candle flame. All are on a par.

But, in spite of all this, it will be urged, there is a distinction between stimulus and response, between sensation and motion. Precisely; but we ought now to be in a condition to ask of what nature is the distinction, instead of taking it for granted as a distinction somehow lying in the existence of the facts themselves. We ought to be able to see that the ordinary conception of the reflex arc theory, instead of being a case of plain science, is a survival of the metaphysical dualism, first formulated by Plato, according to which the sensation is an ambiguous dweller on the border land of soul and body, the idea (or central process) is purely psychical, and the act (or movement) purely physical. Thus the reflex arc formulation is neither physical (or physiological) nor psychological; it is a mixed materialistic-spiritualistic assumption.

If the previous descriptive analysis has made obvious the need of a reconsideration of the reflex arc idea, of the nest of difficulties and assumptions in the apparently simple statement, it is now time to undertake an explanatory analysis. The fact is that stimulus and reponse are not distinctions of existence, but teleological distinctions, that is, distinctions of function, or part played, with reference to reaching or maintaining an end. With respect to this teleological process, two stages should be discriminated, as their confusion is one cause of the confusion attending the whole matter. In one case, the relation represents an organization of means with reference to a comprehensive end. It represents an accomplished adaptation. Such is the case in all well developed instincts, as when we say that the contact of eggs is a stimulus to the hen to set; or the sight of corn a stimulus to pick; such also is the case with all thoroughly formed habits, as when the contact with the floor stimulates walking. In these instances there is no question of consciousness of stimulus *as* stimulus, of response *as* response.

There is simply a continuously ordered sequence of acts, all adapted in themselves and in the order of their sequence, to reach a certain objective end, the reproduction of the species, the preservation of life, locomotion to a certain place. The end has got thoroughly organized into the means. In calling one stimulus, another response we mean nothing more than that such an orderly sequence of acts is taking place. The same sort of statement might be made equally well with reference to the succession of changes in a plant, so far as these are considered with reference to their adaptation to, say, producing seed. It is equally applicable to the series of events in the circulation of the blood, or the sequence of acts occurring in a self-binding reaper.[1]

Regarding such cases of organization viewed as already attained, we may say, positively, that it is only the assumed common reference to an inclusive end which marks each member off as stimulus and response, that apart from such reference we have only antecedent and consequent;[2] in other words, the distinction is one of interpretation. Negatively, it must be pointed out that it is not legitimate to carry over, without change, exactly the same order of considerations to cases where it is a question of *conscious* stimulation and response. We may, in the above case, regard, if we please, stimulus and response each as an entire act, having an individuality of its own, subject even here to the qualification that individuality means not an entirely independent whole, but a division of labor as regards maintaining or reaching an end. But in any case, it is an act, a sensori-motor coördination, which stimulates the response, itself in turn sensori-motor, not a sensation which stimulates a movement. Hence the illegitimacy of identifying, as is so often done, such cases of organized instincts or habits with the so-called reflex arc, or of transferring, without modification, considerations

[1] To avoid misapprehension, I would say that I am not raising the question as to how far this teleology is real in any one of these cases; real or unreal, my point holds equally well. It is only when we regard the sequence of acts *as if* they were adapted to reach some end that it occurs to us to speak of one as stimulus and the other as response. Otherwise, we look at them as a *mere* series.

[2] Whether, even in such a determination, there is still not a reference of a more latent kind to an end is, of course, left open.

valid of this serial coördination of acts to the sensation-movement case.

The fallacy that arises when this is done is virtually the psychological or historical fallacy. A set of considerations which hold good only because of a completed process, is read into the content of the process which conditions this completed result. A state of things characterizing an outcome is regarded as a true description of the events which led up to this outcome; when, as a matter of fact, if this outcome had already been in existence, there would have been no necessity for the process. Or, to make the application to the case in hand, considerations valid of an attained organization or coördination, the orderly sequence of minor acts in a comprehensive coördination, are used to describe a process, viz., the distinction of mere sensation as stimulus and of mere movement as response, which takes place only because such an attained organization is no longer at hand, but is in process of constitution. Neither mere sensation, nor mere movement, can ever be either stimulus or response; only an act can be that; the *sensation* as stimulus means the lack of and search for such an objective stimulus, or orderly placing of an act; just as mere movement as response means the lack of and search for the right act to complete a given coördination.

A recurrence to our example will make these formulæ clearer. As long as the seeing is an unbroken act, which is as experienced no more mere sensation than it is mere motion (though the onlooker or psychological observer can interpret it into sensation and movement), it is in no sense the sensation which stimulates the reaching; we have, as already sufficiently indicated, only the serial steps in a coördination of *acts*. But now take a child who, upon reaching for bright light (that is, exercising the seeing-reaching coördination) has sometimes had a delightful exercise, sometimes found something good to eat and sometimes burned himself. *Now the response is not only uncertain, but the stimulus is equally uncertain; one is uncertain only in so far as the other is.* The real problem may be equally well stated as either to discover the right stimulus, to constitute the stimulus, or to discover, to constitute, the response. The question of whether to reach or to abstain from reaching is the question what

sort of a bright light have we here? Is it the one which means playing with one's hands, eating milk, or burning one's fingers? The stimulus must be constituted for the response to occur. Now it is at precisely this juncture and because of it that the distinction of sensation as stimulus and motion as response arises.

The sensation or conscious stimulus is not a thing or existence by itself; it is that phase of a coördination requiring attention because, by reason of the conflict within the coördination, it is uncertain how to complete it. It is to doubt as to the next act, whether to reach or no, which gives the motive to examining the act. The end to follow is, in this sense, the stimulus. It furnishes the motivation to attend to what has just taken place; to define it more carefully. From this point of view the discovery of the stimulus is the 'response' to possible movement as 'stimulus.' We must have an anticipatory sensation, an image, of the movements that may occur, together with their respective values, before attention will go to the seeing to break it up as a sensation of light, and of light of this particular kind. It is the initiated activities of reaching, which, inhibited by the conflict in the coördination, turn round, as it were, upon the seeing, and hold it from passing over into further act until its quality is determined. Just here the act as objective stimulus becomes transformed into sensation as possible, as conscious, stimulus. Just here also, motion as conscious response emerges.

In other words, sensation as stimulus does not mean any particular psychical *existence*. It means simply a function, and will have its value shift according to the special work requiring to be done. At one moment the various activities of reaching and withdrawing will be the sensation, because they are that phase of activity which sets the problem, or creates the demand for, the next act. At the next moment the previous act of seeing will furnish the sensation, being, in turn, that phase of activity which sets the pace upon which depends further action. Generalized, sensation as stimulus, is always that phase of activity requiring to be defined in order that a coördination may be completed. What the sensation will be in particular at a given time, therefore, will depend entirely upon the way in which an activity is being used. It has no fixed quality of its

own. The search for the stimulus is the search for exact conditions of action; that is, for the state of things which decides how a beginning coördination should be completed.

Similarly, motion, as response, has only a functional value. It is whatever will serve to complete the disintegrating coördination. Just as the discovery of the sensation marks the establishing of the problem, so the constitution of the response marks the solution of this problem. At one time, fixing attention, holding the eye fixed, upon the seeing and thus bringing out a certain quale of light is the response, because that is the particular act called for just then; at another time, the movement of the arm away from the light is the response. There is nothing in itself which may be labelled response. That one certain set of sensory quales should be marked off by themselves as 'motion' and put in antithesis to such sensory quales as those of color, sound and contact, as legitimate claimants to the title of sensation, is wholly inexplicable unless we keep the difference of function in view. It is the eye and ear sensations which fix for us the problem; which report to us the conditions which have to be met if the coördination is to be successfully completed; and just the moment we need to know about our movements to get an adequate report, just that moment, motion miraculously (from the ordinary standpoint) ceases to be motion and become 'muscular sensation.' On the other hand, take the change in values of experience, the transformation of sensory quales. Whether this change will or will not be interpreted as movement, whether or not any consciousness of movement will arise, will depend upon whether this change is satisfactory, whether or not it is regarded as a harmonious development of a coördination, or whether the change is regarded as simply a means in solving a problem, an instrument in reaching a more satisfactory coördination. So long as our experience runs smoothly we are no more conscious of motion as motion than we are of this or that color or sound by itself.

To sum up: the distinction of sensation and movement as stimulus and response respectively is not a distinction which can be regarded as descriptive of anything which holds of psychical events or existences as such. The only events to which the terms stimulus and response can be descriptively applied are to

minor acts serving by their respective positions to the maintenance of some organized coördination. The conscious stimulus or sensation, and the conscious response or motion, have a special genesis or motivation, and a special end or function. The reflex arc theory, by neglecting, by abstracting from, this genesis and this function gives us one disjointed part of a process as if it were the whole. It gives us literally an arc, instead of the circuit; and not giving us the circuit of which it is an arc, does not enable us to place, to center, the arc. This arc, again, falls apart into two separate existences having to be either mechanically or externally adjusted to each other.

The circle is a coördination, some of whose members have come into conflict with each other. It is the temporary disintegration and need of reconstitution which occasions, which affords the genesis of, the conscious distinction into sensory stimulus on one side and motor response on the other. The stimulus is that phase of the forming coördination which represents the conditions which have to be met in bringing it to a successful issue; the response is that phase of one and the same forming coördination which gives the key to meeting these conditions, which serves as instrument in effecting the successful coördination. They are therefore strictly correlative and contemporaneous. The stimulus is something to be discovered; to be made out; if the activity affords its own adequate stimulation, there is no stimulus save in the objective sense already referred to. As soon as it is adequately determined, then and then only is the response also complete. To attain either, means that the coördination has completed itself. Moreover, it is the motor response which assists in discovering and constituting the stimulus. It is the holding of the movement at a certain stage which creates the sensation, which throws it into relief.

It is the coördination which unifies that which the reflex arc concept gives us only in disjointed fragments. It is the circuit within which fall distinctions of stimulus and response as functional phases of its own mediation or completion. The point of this story is in its application; but the application of it to the question of the nature of psychical evolution, to the distinction between sensational and rational consciousness, and the nature of judgment must be deferred to a more favorable opportunity.

STUDIES FROM THE PSYCHOLOGICAL LABORATORY OF THE UNIVERSITY OF CHICAGO.

III. The Organic Effects of Agreeable and Disagreeable Stimuli.

BY JAMES ROWLAND ANGELL AND SIMON F. McLENNAN.

Amid all the recent discussion upon the significance of the activities of the physical organism under conditions of emotional excitement, and in other affective states, there has been an apparent consensus of opinion, that states of consciousness belonging to the two general classes agreeable and disagreeable, are accompanied on the one hand, by conditions of expanded vascularity and heightened muscle tone of the voluntary system, and on the other hand, by vascular constrictions and depressed muscle tone of the voluntary system. The greater emphasis is ordinarily laid upon the vascular alterations and accompanying disturbances in the involuntary system. The confidence in this doctrine rests upon a fairly wide basis of experiment, and yet certain restricting corollaries need to be pointed out. The present piece of work, forming part of a broader inquiry into the nature of affective states, can only hope to add a mite to the general store of information upon the topic in hand.[1] Nor does it pretend to deal with the more fundamental physiological aspects of the problem still left unsolved. For example, we have no theory to offer, and no conclusive evidence to show, whether the fluctuating vascular conditions to be commented upon are due entirely to alterations in the action of the heart, or in part to the vascular system; nor yet whether the dilators or constrictors of the latter system or both are concerned in producing the changes.

[1] Many of the points we shall touch upon have already been more or less fully reported, but seldom with any proper emphasis on their connection with one another, which is what we shall dwell on.

Incidentally we may say that the frequency with which alterations of breathing, pulse beat and blood supply occur in conjunction, would point to the probability that the effects are due to no one set of organic processes, but rather to diffused disturbances in several of the higher centers. This diffusion might, of course, be a secondary phenomenon of the nature of a reflex, discharged from a center primarily affected, but the results give no evidence specially suggestive of such a state of things.

This general class of considerations, however, appears to us to possess less immediate importance than those which we propose to urge. We desire to emphasize, on the basis of a large number of experiments (we retain as trustworthy over 1,100 of all we have made), conducted under conditions of great care, certain fundamental difficulties connected with this method of investigating affective states. While offering very little that is distinctly new, we purpose to bring into strong relief the discrepancies of the method, and to call in question again the exact significance and worth of results attained through its use.

Before proceeding to a detailed discussion of our subject, a few words are in order concerning our apparatus, method of work, etc.

A modification of Mosso's plethysmograph, hung in a swing, served to give us both the vasomotor disturbances and the pulse beat. The plethysmograph was connected with Marey tambours writing on the drum of a Stoelting kymograph—a machine which is practically noiseless and exceedingly constant in its running. The hand and arm up to the elbow were immersed in the water of the plethysmograph. The changes in the breathing were registered by means of tambours arranged as a pneumograph. A wooden spur attached to the breast and pressing against a tambour permitted us to get the slightest fluctuations. We abandoned the use of a cardiograph and sphygmograph, upon finding that our other arrangements were going to give us the essential points in which we were interested, at a great saving of labor. The senses of smell, taste, hearing and sight were experimented upon, such stimuli being used as would, supposedly, produce affective states readily distinguish-

able as agreeable, or disagreeable. For sight stimulations rotating disks were employed; for smell, cologne, bayrum, assafœtida, iodoform and turpentine were used; for taste, sugar, salt, capsicum and quassia; for sound, (1) noises of various kinds, *e. g.*, rasping, snapping, grinding, (2) tones from mounted tuning forks. The external conditions, atmospheric and otherwise, were kept as constant and favorable as possible. The subjects, with whom most of the work was done, were selected from a considerable number of students, as being those who gave the most unequivocal results.

Stated again and a little more narrowly, we were concerned with the interpretation of certain organic disturbances due merely to processes, *initiated* in the centers, as compared with those due to *peripherally* excited affective conditions. We noticed very early in the experimentation that the alterations in organic conditions under examination depended, as has been recognized,[1] in very large measure upon the thorough processes at that time in progress. It is, of course, impossible to control these entirely, and the difficulty is increased when, as in the present instance, it becomes highly desirable to have the mind as nearly quiescent as possible in order to obtain unmistakable evidence of the alterations due to the various stimuli employed to produce the agreeable and disagreeable states. That is to say, before drowsiness comes on, as it generally does, if the mind is kept quiet for a little, it is often necessary to make considerable effort of attention to keep the thought processes from running off into all sorts of vagaries of revery, any portion of which may call up affective disturbances. The mind, if kept 'empty,' as we say, is frequently kept so only with strain, and this strain then diverts attention from the incoming stimuli and so complicates the affective conditions, which they are intended to set up. Thus, one gets the not affective state brought on by stimulus, but the affective state modified by and blended with the prevailing mental state, which may itself be already affective, or in any event unfavorable to the unambiguous effectiveness of the stimulus. In this connection we found that by artificially

[1] In this general connection may be mentioned Mosso's observations upon attention and cortical circulation.

altering the thought processes, regardless of the external stimuli, organic disturbances could be produced essentially similar, in kind if not degree, to those which occurred under the affective conditions induced by peripheral stimulation. Indeed, were there not experimental evidence for it, one might fairly anticipate, from the general interconnection of mental and bodily states, that the change in mental processes would, regardless of its affective tones, manifest itself in some change of bodily condition.

To be still more specific on this head, we find, for instance, that disagreeable stimulations of taste and smell produce incoordinated and spasmodic breathing, depressions and irregularities of pulse and decrease of blood supply to the periphery —meaning by the periphery not simply the skin, but the total member concerned, in this case the hand and forearm. These conditions become increasingly violent and spasmodic, as the intensity of the stimulation and the lack of expectation in the subject increases. The degree of uniformity in this increase we have not attempted to measure accurately. The general fact, has, however, been shown clearly. Moreover, the after effect as revealed in these ways continues for a very considerable time. A reverse condition in the organic processes manifests itself when agreeable stimuli of moderate intensity are employed, with a somewhat important exception to be mentioned later. But now we find these identical motor disturbances repeated in the same form, though generally in less degree, when the subject is left to his own meditations, or when he is required to indulge in mental gymnastics, such, for example, as performing mathematical calculations and this too, quite regardless of any peripheral stimulation. Similar results show themselves when the subject is allowed to read. Often marked changes in the breathing and blood supply—less marked in the pulse—occur when the thought process reveals little or nothing adequate, subjectively considered, to produce the disturbance. These fluctuations could, of course be accounted for on purely physiological grounds, as due to changes in the chemical conditions in the blood, brought on by any one of a dozen physical causes directly affecting the centers. But when

the mind is kept perfectly passive, and especially when the first stages of sleep are coming on, we find, almost without exception, that all these organic processes are quiet and undisturbed. This fact tends to render it probable that the changes are often, if not always, caused by cortical conditions regarded independently of the mere physical environment. We have already stated that the atmospheric conditions, etc., were kept as constant as possible. It is possible that some of these results are due to what one may call the general mood, which prevails at the time, but this does not militate against our contention.

From the standpoint of method then, we must maintain that any attempt to use these particular organic activities as avenues of approach, in the study of delicate affective conditions, appears essentially impossible, at least with any appliances now at hand. And this not because affective conditions are not represented here, but because so many other factors, in no fair sense to be recognized as affective, enter in. In the case of coarser affective states the results of previous investigations are substantially corroborated by our own.[1] But it is not *invariably* true that the deliverances of consciousness and the performance of the organism coincide, *e. g.*, it does not *always* occur that a stimulus pronounced agreeable is followed by observable increase of blood supply to the periphery. Indeed, there is considerable difficulty in obtaining stimulations of short durations, whose effects, therefore, are at

[1] Without furnishing a complete tabulation of our results, which could not, unless accompanied by cuts of the curves, be made very intelligible, we may say, that with stimulations felt as clearly disagreeable, about 90% of all the cases show a fall in the various curves. The percentage of cases of rise in the curves, corresponding to agreeable stimuli, has been considerably smaller. But this is in large measure, no doubt, to be accounted for by the relative weakness of the pleasure tone arising from the stimuli. The difficulty encountered in obtaining stimuli to produce agreeable affective states is mentioned elsewhere in the paper. In cases where the subject reports the stimulus as indifferent, we get both kinds of result, with consequent ambiguity in the significance.

It is interesting to note, that in cases where the attention was strongly focused on intellectual activities, such as reading or mental arithmetic, about 25% of the results show alliance with the agreeable affective states by a slight but continued rise in the curves, while 75% show a more or less sudden and marked decrease. The disturbances in these processes, due to mere shifting of the attention, have already been somewhat studied abroad. It remains for someone to work up the significance of these facts for a psycho-physical theory of æsthetics.

all readily comparable, which possess any considerable strength of pleasure tone. Nor is there any obvious and exact correspondence in the degree of the subjectively expressed feeling tone with the *amount* of the disturbance in the organism. Stimuli to the various senses naturally show the widest differences in the degree which they affect particular ones of these processes, and the subjective effect keeps pace only in a general and often remote way. For example, agreeable and disagreeable odors influence the breathing process in a very pronounced manner. A very faint whiff of ammonia will in a merely reflex way produce considerable disturbance of this character, and yet, it may not be judged so disagreeable as a flickering light, which brings about much less change in these organic processes. So we feel justified in reiterating that the very complex conditions, under which affective states may be and are induced, renders it essentially impossible to employ this means of investigation, when delicate results are sought. In any event the general statement that agreeable states and disagreeable states are accompanied respectively by increase and decrease in the functional activities of the organic processes here considered, requires to be offset with the statement that other mental conditions, besides those subjectively recognized as affective, produce similar results, and that the amount of the bodily manifestation does not seem to run exactly parallel with the subjective estimation of the agreeableness or disagreeableness of the conscious state.

We mentioned above a minor point of divergence from most observations upon which we should comment. It is this, not infrequently it happens that a stimulus felt to be pleasurable, produces for a few seconds a decrease in the blood supply to the periphery and then a subsequent increase. So far as we could determine, this was in no sense due to the intensity of the stimulation, for then we should with relatively intense stimuli obtain subjective conditions, in which the agreeableness was questionable, but rather to a condition psychologically equivalent to shock or surprise, and springing in the case of our experiments from even the slightest maladjustment of expectation. This was by no means of sufficient intensity always to excite notice on the part of the subject, but it tends to lend new and striking testi-

mony to the intimate connection of attraction with affective conditions. For, stated again and more concisely, we have here a case of an agreeable stimulus producing the characteristic external manifestations of a disagreeable stimulus, not because the existing mood, or affective state, is unpropitious, for both these may be neutral, but simply because the adjustment of the attention is not perfect. This peculiarity was especially marked in the case of the tuning-fork stimulations. We had supposed these would in most cases be felt as agreeable. But this was far from being always the case when at all loud, or long continued, or unexpected, they became distinctly disagreeable.

In conclusion, we may be permitted, perhaps, to insist that out of the purely negative considerations, which we have been urging, certain equally positive inferences are to be drawn. We believe that the results traversed in what we have said lend striking confirmation to the essential solidarity of consciousness, and to the utter futility of attempting to attack the problem of the peculiarities of any one aspect, without due regard to all the others involved. Affective states as such do manifest certain fairly constant and experimentally demonstrable motor expressions, but the same motor expressions are also characteristic of other conscious states, not recognizable as predominantly affective; nor do the bodily manifestations of these affective states run absolutely parallel with the latter. Observable changes in the one do not always betoken observable changes in the other. The impossibility of asserting in any particular case the relative significance of the bodily modifications for the affective state on the one hand, and the merely intellective, or cognitive, state on the other, renders it exceedingly problematic how one is to interpret results gained from this method. It is greatly to be hoped, however, that we may have a really careful test made on the intensive side of the exact relation obtaining between the amount of the bodily manifestation, and the subjective estimate of the degree of the agreeableness or disagreeableness felt.

IV. Simultaneous Sense Stimulations.

Practice Study.[1]

BY AMY TANNER AND KATE ANDERSON.

The published work of Urbantschitsch,[2] who has apparently made the most extended examination of the phenomena under consideration, contains no account of apparatus and but little of his method of procedure. The present study has been carried on with special reference to the peculiar effects produced upon attention and the interpretation of the same. In general, we find confirmation of Urbantschitsch's reported observations, but the wide divergences shown by his different subjects, and by the same subjects under different conditions, together with his apparent disregard of the effects of attention, render it probable that much of his report is untrustworthy and that more careful experimentation would give less equivocal results. We have confined ourselves to the partial interaction of auditory, visual and electrically stimulated tactual-muscular sensations, whereas Urbantschitsch examined the effects of the stimulation of each sense upon all the others.

Stated in terms of attention, the problem is this: When attention is focused upon a barely perceptible sensation, does the addition of another sensation render the first more or less perceptible? Or, in another form—is the threshold for any sensation raised or lowered by the presence of another sensation?

The same question can, of course, be put from the purely physiological side. Is the functional activity of any sense organ conditioned by the activity of any other? Is the inertia of the central nervous tracts connected with any sense organ affected by excitation in other sensory regions? The question is, however, essentially psycho-physical, and no solution which neglects this truth can really do justice to all the facts.

[1] In accordance with the usage of the laboratory in which their work has been done, the authors, in connection with an introductory course, began this study in a field *already* worked, in part for merely disciplinary purposes, in part to determine how adequately and carefully the previous investigations had been conducted.

[2] *Pflügers Archiv.*, 1888.

We find that in a large majority of cases, visual sensations just below or just at the threshold are, upon the introduction of a second sensation from either the same or another sense organ, brought clearly above the threshold. We find that in some considerable number of cases the mere enlargement of the field of attention results in a brightening of the center of the field. Upon this point Ladd[1] states: "Distraction of attention, if the aggregate of psychic energy be not increased, necessarily follows upon the introduction of any such new factor or object." If this statement be true, we must, on the basis of such results as are here offered, assert that the sum total of psychic energy is increased, ordinarily, if not invariably, when a new stimulus is given. Such a conception is certainly not current in our text-book treatments of sensation.

If we make sharply the distinction between the content of attention and the attentive activity itself, and also the distinction between attending to a clear sensation, and clearly or intensely attending to a sensation, then our results compel us to revise the old statement that the more things we attend to simultaneously the less clearly do we perceive any one, and to say that, when attention is directed to a content presented to any one sense, the simultaneous stimulation of other senses may enlarge and render more clear the field of the first sense, though we cannot speak with entire confidence as to whether or not the *activity* of the attention in this direction is or is not increased.

In merely neural terms the results seem to mean that the nervous system represents at any moment a certain amount of inertia; that this is attacked by every sense stimulation, and that the inertia of any region, such as that represented by the visual tracts, may be in part so overcome by disturbance from other regions, that nervous impulses otherwise ineffective may successfully penetrate to their appropriate cortical centers and there set up the processes which parallel consciousness. This result probably extends in some cases to the sense organs themselves. A portion of our experiments comes under this latter head. Such are the answers to our original inquiries when expressed in both psychical and physiological terms.

[1] *Psychology, Descriptive and Explanatory*, p. 72.

The tests here reported were made during the spring and fall of 1895. Three months were occupied in perfecting apparatus and making preliminary experiments. The present report refers to six weeks of work done under the improved conditions.

Our apparatus consisted of three tubes — light-tight, blackened inside, and sliding into each other. At one end was a perforated pasteboard slide arranged so that the light from colored glasses could be seen through the perforations. The light was daylight, reflected from a white pasteboard in front of the slide, and the glasses used were red, yellow, green and blue.

The auditory stimuli were given by tuning-forks of 256 v. and 2048 v., and also by the whirring noise of the vibrator on a DuBois Reymond coil. The intensity of the tones of the forks was controlled by a ball pendulum which was employed to strike them. Electrical stimuli from the coil were used to stimulate the skin of the palms. The added visual stimuli were colors of the same size as those first exposed. This case, of course, introduces the question of merely retinal peculiarities as distinguished from central effects. In the cases here reported the intensities of the stimuli were kept constant. In passing we may say that from other tests we incline to think, in opposition to Urbantschitsch, that the observable changes due to alterations of intensity are, except near the upper and lower limits, of relatively small significance.

The experiments were carried on in a quiet room in which experimenter and subject were alone. The subject sat at the open end of the tube with his face supported by a head-rest, and his head and shoulders covered by a camera cloth so that he was in total darkness and could see none of the operator's movements. We used only the right eye in our experiments, and in order to cover the left, and yet not strain it, the subject wore spectacles in which the right glass was removed and the left covered with black felt.

In order to obtain good conditions each subject was used only twenty minutes a day, and in case of unusual fatigue, cold, etc., was not used at all. Every precaution was observed

to prevent the subjects from knowing either the purpose or results of the tests. In working for such purposes, with sensations near the thresholds this is indispensable to accuracy.

The method of procedure was as follows: At the outset of the experimentation the color thresholds for the various subjects were determined by means of the sliding tubes. After a brief pause, some one of the colors was shown, either at or just below the threshold. Then the second stimulus was given and the effect on the color reported. The length of time consumed by the various parts of the test was kept fairly constant, save that occasionally a little longer time than usual was allowed for the giving of the second stimulus, in order to be sure the changes were not due to pulses of attention, which so certainly figure in the report of Urbantschitsch. The greater constancy of our own results also argue in favor of this conclusion.

TABLE I.*

	Added Stimulus.—2048 v. fork.					Added Stimulus. 256 v. fork.				
	Continued Stimuli.				Totals.	Continued Stimuli.				Totals.
	Yellow.	Blue.	Green.	Red.		Yellow.	Blue.	Green.	Red.	
Faintly perceived	14	32	28	38	112	14	30	18	45	107
Unperceived.	5	19	14	17	55	1	11	8	13	33
Wrongly perceived.	41	9	18	5	73	45	19	34	2	100
Color brought out or intensified	49	56	56	57	218	52	53	51	56	212
Unchanged.	11	4	4	4	22	8	7	9	4	28

* In all these tables the number of subjects is three; and twenty tests were made with each of the subjects with each of the continued stimuli.

Table II.

Added Stimulus—Red. Continued Stimuli.	Yellow.	Blue.	Green.		Totals.	Added Stimulus—Yellow. Continued Stimuli.	Blue.	Green.	Red.		Totals.
Faintly perceived.	41	29	45		115		15	39	28		82
Unperceived.	18	30	12		60		45	21	22		88
Wrongly perceived.	1	1	3		5		0	0	10		10
Color brought out or intensified	54	51	54		150		41	59	49		150
Unchanged.	6	9	6		21		18	1	11		30

Added Stimulus—Blue. Continued Stimuli.	Red.	Green.	Yellow.		Totals.	Added Stimulus—Green. Continued Stimuli.	Red.	Blue.	Yellow.		Totals.
Faintly perceived.	13	15	41		69		17	9	47		73
Unperceived.	33	44	18		95		42	51	9		102
Wrongly perceived.	14	1	1		16		1	0	4		5
Color brought out or intensified	42	47	36		125		48	48	47		143
Unchanged.	18	13	24		55		12	12	13		37

Table III.

Added Stimulus.—Electricity. Continued Stimuli.	Yellow.	Blue.	Green.	Red.	Totals.	Added Stimulus.—Noise. Continued Stimuli.	Yellow.	Blue.	Green.	Red.	Totals.
Faintly perceived.	27	9	2	18	56		58	21	17	30	108
Unperceived.	8	20	34	30	92		1	6	24	14	45
Wrongly perceived.	25	31	24	12	92		20	32	19	16	87
Color brought out or intensified	27	23	34	26	110		25	21	27	22	95
Unchanged.	33	37	26	34	130		35	39	33	38	145

TABLE IV.—RESULTS.

Number of tests.	Faintly perceived.	Unperceived.	Wrongly perceived.	Color brought out or intensified.	Color unaffected.
1680	722	570	388	1212	468

From the above experiments we see that 72+per cent. of the whole number gave positive results; with the 2048 fork, 90 per cent.; with the 256, 88 per cent.; with red, 88 per cent.; with yellow, 83 per cent.; with green, 80 per cent.; with blue, 70 per cent.; with electricity, 46 per cent.; with noise, 40 per cent.

The fact that only 40 per cent. of the experiments with noise are positive, contradicts the assumption that the results vary with the sense. Otherwise we might say that the associations of eye with ear are closer than those of one part of the retina with other parts, or than those of hand with eye. Further experiments may show that pleasure and pain have some constant relation to the effects; but here, so far as inquiries were made, the added stimuli were indifferent, except the electricity, which was disagreeable to A. A. F.

With colors, the red and yellow, which gave the largest per cent. of positive results, are visible at greater distances than the green and blue. But where red and yellow are the continued stimuli the results are no more positive than where green and blue are. That red and yellow should have this peculiarity apparently furnishes another presumption in favor of Heiny's theory.

Although the conditions were not all that could be desired, we failed, in connection with a considerable number of tests conducted by Miss Faith Clark, to find any *constant* positive effect upon the accommodating apparatus of the eye, either from the stimuli here mentioned, or from gustatory or olfactory stimulations. The elimination of the disturbances due to fluctuating attention on this form of the experiment are much more difficult and require much more delicate appliances.

SOME REMARKS UPON APPERCEPTION.

BY J. KODIS,

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The great significance which the conception of apperception has obtained in modern psychology necessitates a thorough understanding of the content of this conception. An historical investigation of the meanings that have been ascribed to the conception of apperception gives no positive and satisfactory result; not only has apperception been differently conceived by different philosophers, but many philosophers have used one of these conceptions for another, and even in the construction of a 'theory of apperception' have blended together a number of different psychical phenomena. Nevertheless, in order to analyze this notion, it will be necessary to arrange the separate types of these different conceptions into their different classes.[1]

In all we are able to gather from the history of psychology three types of the notion of apperception.

1. Apperception as an event which imparts clearness to representations.

2. Apperception as reflective knowledge.

3. Apperception as an act of knowledge produced by the impact of two groups of representations.

(1) *Apperception as an event which imparts clearness to representations.* The historical development of this conception begins with Descartes in his definition of a clear perception, his 'clear perception' being namely, one which manifests itself immediately and explicitly in an attentive intellect (Principes de la phil., trad. par Aimé Martin, p. 29f), just as when an object sufficiently affects the eye and the latter is disposed to see it. This conception was also used by Leibnitz in the 'Nouv. Ess.'[2]

[1] In regard to the proof for this affirmation see my 'Zur Analyse des Apperceptionsbegriffs.' Calvary & Companie, Berlin.

[2] *Nouv. Ess.*, p. 23, *Opera philosophica.*

According to the definition found there, apperception is to be distinguished only quantitatively from perception; from the summation or the strengthening of perceptions arises apperception. Lately the word apperception has been much used by Wundt in the sense of the clear perception of Descartes. This is particularly marked in his use of the Cartesian illustration in which perception is compared with a visible object. Perception, according to Wundt, corresponds to vision in the field of vision, apperception to vision in the fovea centralis.[1]

(2) *Apperception as reflective knowledge*, '*connaissance reflexive*.' This reflective knowledge consists in the act of thought, concerning the relation of the object of recognition and the thinking *ego*.

The first to ascribe this meaning to apperception was Leibnitz,[2] but this conception was left by him relatively undeveloped. He defines reflective knowledge as an act of thought about something that is taking place in our *ego*. This theory was taken up and extended by Wolf. According to Wolf, when we become conscious of the perceived object, we perceive a certain act of the soul, namely, apperception. We distinguish ourselves at once as perceiving subject from the perceived object. We recognize that the subject is different from this object.[3]

The fullest development of this theory is attained in the conception of Kant in his concept of transcendental apperception, which is namely the representation of the *ego* in relation to all other representations.[4] 'This original and necessary consciousness of the identity of self,' being at the same time the consciousness of an equally necessary synthesis of all phenomena through representations.

In many respects Wundt's theory is similar. Indeed, according to Wundt, apperception is at bottom the same function as will. But the essence of will is the feeling of individual doing and suffering.[5] This feeling, considered by Wundt as the single permanent state of the soul is what Kant designated

[1] *Phys. Psych. cf.* p. 236 f II, 4 Auflage.
[2] *Monad.* p. 15 f.
[3] *Psych.* Ration. p. 19.
[4] *Krit d. r. Vern.* p. 121, 2 Aufl. ausg. v. Kehrbach.
[5] *System* p. 384.

the transcendental *ego*. Thus apperception is the first manifestation of the will, which forms at the same time a basis for the continuity of consciousness and the identity of the individual.

(3) *Apperception as the production of knowledge through the impact of two groups of representations.* This conception of apperception was originated and developed by Herbart and his school. According to this conception, apperception is the process by which the incoming representation sets in motion already existing representations and at last, according to the laws of psychical mechanics, produces an end result, which must be considered as dependent on all active forces. This theory is based upon the assumption of an eternal existence of the representations and an artificial psychical mechanics, whose laws, carried out speculatively, are assumed to be analogous to physical laws.[1]

These are the three types of the definition of apperception, disclosed by an historical survey. Has one of these definitions a stronger claim to existence than another? Are all three definitions a delineation of three different phases of the same event, or are all three definitions a delineation of three separate and distinct events, which are classed as one and the same? And is apperception in all or any of these theories conceived as an especial and important function of the soul: as an especial form of activity? We can hope to answer these questions only by an analysis of the psychical acts, which have given rise to these psychological theories. Such an analysis necessitates the rejection of all speculative elements, and the setting forth of the psychical facts of experience, which are the kernel of these theories. This is the method, which will be attempted in the following pages.

Apperception as an Event which Imparts Consciousness or Clearness to Representations.

It is known that Kant used the conceptions apperception and consciousness interchangeably and this interchange is often ob-

[1] It may be noticed here, that the meaning which Steinthal, a disciple of Herbart, attributes to attention, is nearly the same as the meaning of apperception in the sense of 'Connaissance reflexive.' See *Einleitung in d. Psych.* p. 231. 2 Aufl.

served in all philosophers, who have occupied themselves with the theory of apperception, most of them having used as synonyms clearness and consciousness. But when it is a question of defining 'Clearness' more particularly the two definitions of apperception and clearness usually differ. According to Kant, 'empirical apperception' is the consciousness of self, as determined by our condition (Krit d. r. Vern. p. 673, 2 Aufl. Kehrbach), and 'clearness' the state, where the consciousness of a conception rises to a consciousness of its difference from other conceptions (p. 692). Thus notwithstanding that apperception, as an event, which imparts clearness to conception, may be easily identified with consciousness, this identification has been avoided, whenever the question of exactness arose.

The reason for this lies probably in the fact that most psychologists (with the exception of Steinthal) who have elaborated the apperception theory have used not the conception of *consciousness as a state*, but the conception of *consciousness as a substance*. On the other hand, the conception of *apperception as a function* of consciousness could not pertain to a substance. Consequently the relation of apperception and consciousness was as follows: Consciousness was believed to have the power of giving greater clearness to representations, this power being nothing else than apperception. In this way when we possess a representation, its clearness is not an inherent element, but something added to it by some extra power of consciousness. Apperception does not create clearness or consciousness, but serves to divide and to heighten it.

In addition to consciousness, considered as a substance, a ground for the assumption of an especial power of the soul for the regulation of clearness lies in the fact that the most intensive representations are not always the clearest. This problem of the separation of intensity and clearness is familiar to all who follow the history of modern psychology.

In reference to this problem it has happened as with many other problems, that it was not solved, but postponed, *i. e.*, since no fixed relation could be determined between intensity and clearness, the regulation of intensity was attributed to an es-

pecial power of the soul. This power of the soul, *i. e.*, apperception, was enabled to perform its function *spontaneously*. In this way it was believed possible to overcome the difficulty of distinguishing the phenomena of clearness and intensity in representations.

Recently this theory has been modified by Wundt. The regulation of consciousness is ascribed not to the metaphysical spontaneity of the soul, but to the empirical faculty of the will. The state of affairs is in consequence not greatly changed, since the metaphysical spontaneity of the soul is hereby simply relegated to the will, to which is given the creative power in evoking representations. In order to enter clearly into the foregoing questions, it is necessary to consider more closely the relationship between intensity and consciousness, and the theory of the spontaneity of the soul.

The Separation of Intensity and Consciousness in Psychical Phenomena.

The natural presumption is, that the most intensive in the psychical life is at the same time the clearest. This presumption is perhaps based upon an unauthorized generalization from a fact often observed. But wider experience shows us that often representations so weak as to be almost unable to awaken any considerable feeling suddenly rise into complete clearness. To explain this phenomenon Herbart enunciated his law of 'Hülfen,' according to which representations rise into consciousness, not met by reason of their own force, but in consequence of a favorable combination with other representations they are enabled to awaken consciousness and to thrust into the background other representations. In recent times two opposed theories are held in relation to this problem: the theory of association and the theory of will, but neither of these theories is sufficient to explain the problem and the adverse criticism of the adherents of both these theories is justified. In fact, if we ascribe to the will the bringing into consciousness of representations, it is necessary to consider will in a certain measure anthropomorphic. Since we know that we *choose* among conceptions, we now attribute this faculty to the will. It is no longer the man who executes

the choice, but his will acts in this manner. The matter is thereby rendered not in the least clearer. What we have hitherto ascribed to our entire human nature is merely relegated without warrant to a province of our nature. This theory is furthermore unwarranted since it excludes the possibility of a consistent carrying out of the principle of the dependence of the psychical phenomena upon the physiological condition of the organism. The physiological phenomena are determined by the law of causality and subject to the law of the conservation of energy. A free activity of the will could in nowise be attached to such a strictly determined condition.[1]

Although the association theory does not contain this fundamental mistake, it is nevertheless insufficient, since it has not succeeded in giving the characteristics of the psychical phenomena which are conditions of a higher grade of consciousness. So it remains unknown, why in the whole mass of knowledge of the individual only especial representations and conceptions are able to undergo such associations that they reach the highest grade of consciousness.

The fault of these theories lies in the fact that they proceed to explanations before all the facts are discovered and their relations to one another described. In addition, in spite of the wish of many psychologists, that the objective, *i. e.*, the physiological condition of consciousness should be determined, most authors make no effort to do so. And yet this is the only way to obtain a general solution of the problem. Only on the basis of the relationship between psychical phenomena and central nervous processes, can we pretend to reach a satisfactory explanation.

Such an attempt we find in the theory of R. Avenarius (*Kritik d. reinen Erfahrung*, p. 51, B. I and p. 18, B. II), which considers intensity and consciousness as dependent on the centro-nervous processes from which they derive their especial character. In this way the difference between intensity and consciousness (in the sense of state of consciousness) is kept distinct. We know from experience, that the intensity among physical phenomena is dependent upon the size of the

[1] *Zur Analyse des Apperceptionsbegriffs*, p. 135.

waves. Hence we approach the supposition, that the *intensity of our representations depends immediately upon the size of the centro-nervous vibrations of a thinking individual.*

Concerning consciousness (consciousness considered as a state), we see that through the variations in the environment of an individual the consciousness of the individual may be transferred from one object to another. This fact leads us to the affirmation that *consciousness depends upon some deviation from the customary arrangement of the vibrations in the centro-nervous system* (Krit. d. r. Erf. See *Abhebung*, p. 57, B. II). Thus, since it often happens, that the increase in intensity of one part of the general impression is sufficient to change the customary arrangement of the centro-nervous vibrations it comes about that intensity and consciousness coincide.

The scientific value of this theory is apparent, since it is possible through variations in the environment of the individual or in his customary mass of knowledge to bring about a conscious state and to conduct the consciousness from one representation to another. We can proceed experimentally to augment or to decrease the intensity, we are able also to augment or to decrease consciousness in proportion to the time, which passes during the variation of some customary mass of knowledge.

Spontaneity in the Production of Representations.

The theory of spontaneity was formed by Leibnitz upon the ground of 'inner experience.' He declared in a letter to de Bayle: "L'experience interne refute la doctrine Epicurienne." According to him the spontaneity of the soul is necessary in order to explain that which we have observed in the 'inner experience.' Thus we see from an historical investigation that the ground which we mentioned above for the assumption of the spontaneity of the soul, namely, the separation of the phenomena of consciousness and intensity, is not the only one. An element presumably still more important lies in the fact that *we are able, without any known external cause to originate independent chains of thought.*

A third ground for this affirmation lies in the fact, that we

are able to experience directly the feeling of the spontaneity of our acts. With the first of these three reasons, we are at present not occupied, but when we investigate the two latter more closely, we see that the explanation of these facts by means of the help of the theory of spontaneity arises from the old tendency to consider psychical phenomena of a central character as independent of physiological processes. But if we enter the ground of the dependence of psychical phenomena upon physiological states of the nervous system, there disappears the inconceivability of both the independent production of chains of thought and the sensation of spontaneity.

Indeed, it is well known to the physiologist, that the activity of the nerves arises not only in consequence of peripheral stimulation, but also as a result of the nutrition of the centers. The functions of the organism, which originate by means of the latter method, are the so-called 'automatic functions.' This automaticity of the central nervous system originates nervous processes, which have as correlates chains of thought, the causes of which can not be traced to other psychical phenomena. This fact has long been known and used in psychiatry, in the treatment of disturbances arising from an under or an over supply of blood to the brain.

We see, therefore, that the spontaneity of the soul is requisite to explain facts of this kind, but under the condition that we derive the psychical states unreservedly one from another as we do in dealing with physiological states. But so long as we retain the conception that psychical states are the corollaries of physiological states, which follow among themselves the law of causation, the theory of spontaneity remains useless.

The third ground for the assumption of spontaneity, the direct sensation of impulse in thought, has been so much discussed that this feeling no longer plays a rôle as something of mysterious importance. Although psychological analysis has not yet definitely determined, whether this feeling rests upon sensations coming from the organs and from muscular contractions, or whether it is a sensation of motion, produced in the central nervous system, it is nevertheless classed among the feelings under the name of a *feeling of innervation*. Consequently it is

subject to the same laws as other feelings. Thus we see, that all three reasons for the acceptation of the spontaneity of the soul prove worthless. Consequently, apperception, as an event, which imparts clearness to representations is a useless conception, which really means no more than clearness, and has grown out of a conception of consciousness as a substance and rests upon a false idea of the spontaneity of the soul.

Apperception as Reflective Knowledge.

Apperception, in the sense of reflective knowledge was first taken into consideration as a fact of observation, but afterwards this fact received explanations, which came to be substituted for the fact itself. Naturally, through this circumstance, the whole theory, instead of being elucidated, was considerably obscured. We shall now endeavor to determine the results of observation.

When we recognize with full consciousness something that belongs to the world of thoughts or of affairs, this act of recognition is bound up with a *feeling of appropriation*. We know and feel at the same time, that *we* appropriate it, *i. e.*, *the ego appropriates the thought or the object which confronts it*. Along with this act we experience *feelings from the organs*, corresponding to the way, in which the knowledge originates. Thus we feel that an object is *perceived* or a thought is *conceived*.

Knowledge through reflection is, therefore, nothing else than a becoming conscious of this especial content of knowledge. In fact, according to the authors of the theory of reflective knowledge, the latter is merely the bringing into relation of the *ego* to an object thought of or perceived. That is to say, it is *the act of becoming conscious of the fact, that a certain determined value is thought of or perceived by the ego*.

Reflective knowledge, as this especial content of knowledge deserves indeed the important place that has been assigned to it in psychology, as will be seen from the following statements: Only a part of this content of knowledge is varied during the course of the individual life, namely, things or thoughts which form objects of recognition, for the *ego* with the organic feelings, which accompany perception or ideation, remains ever the same. It is, so to say, a *constant* in the psychical life.

Kant expressed this fact in the well-known proposition that the conception of self accompanies or may accompany every representation. In modern philosophy it has been especially pointed out by W. Schuppe[1] and R. Avenarius[2] that the *ego* and its *experiences* form a *single* system. Both *the self and its experiences belong always and inseparably together.*

But since notwithstanding that the representations of the *ego* may accompany every state of consciousness, this accompaniment does not always take place, we must determine more accurately what are the facts. Although the self and its experiences form a system in which the self represents a relatively unchanging member, nevertheless, the self is also an object of experience like all other experiences. Thus it is possible that the self with its experiences forms a content of knowledge, but on the other hand, it is possible that this content is formed only by the experiences of the self, *i. e.*, by things or by thoughts. In this case not the whole system of the self with its affairs and its thoughts is known, but only a part of the same. Not the whole relation is recognized but only one of its members is *absolutely* apprehended.[1] So for example, when a man recognizes a table and reflects only upon this object, he perceives the table *absolutely*. If, however, he recognizes the table as an *object perceived by him*, it is a case of *relative* knowledge. So it may be seen, that every absolute act of knowing may pass over into a relative act of knowing.

Is Reflective Knowledge an Especial Function of Mind?

We have stated above that reflective knowledge is a *content* of knowledge, which is deserving of especial attention. The question now arises whether reflective knowledge is not an especial function of mind? Apperception in the sense of reflective knowledge has generally been considered an especial function of the soul, even the highest function. We have seen

[1] *Erkentnisstheoretische Logik.*

[2] *Weltbegriff.*

[1] I use the expressions 'absolute' and 'relative' knowledge according to the terminology of Avenarius in *Weltbegriff*, p. 15.

already that knowledge through reflection is knowledge that is directed to the relation between the *ego* and its affairs and thoughts. But among our thoughts there are countless cases of knowledge directed to relations. Therefore, we can believe that reflective knowledge is a special function of mind only when the relation between the self and its thoughts and affairs includes elements of an especial nature.

The relation between the *ego* and its experiences was indeed conceived as something especial and different from all else. The reason for this lay in the conception of the *ego*, as a territory sharply bounded off from its whole environment. In this enclosed province the 'inner experience' was believed to reign. On the contrary the events of which the *ego* took cognizance were conceived as lying in the province of the 'outer experience.' As the two sorts of experiences were believed to be fundamentally different, apperception was assigned the important rôle of bringing the 'outer experiences' into the 'inner experiences' of the *ego*. The outside world was to be brought by apperception into the *ego*. The 'outer experiences' must come into contact with the 'inner experiences.'

So long as we remain in the province of the philosophy, which assumes the 'outer' and the 'inner' experiences as fundamentally different, we must accept 'apperception' as a special function of mind. But in case we do not accept the two kinds of experiences, as things fundamentally different, we cannot accept the act of bringing these experiences into relation as an event, which is peculiar among examples of relative thinking. Given the content of reflective knowledge, it is not possible by psychological analysis to prove the bringing of the 'outer experiences' into the 'inner experiences.' We have been able to prove only the feeling of appropriation, a state which depends upon certain modifications in our sensation of motion. Therefore, so long as we remain upon empirical ground we cannot receive as an element of apperception the act of bringing the 'outer' into the 'inner' experience. This is merely a theory based upon the assumption of a fundamental difference between the inner and the outer world—only a method of elucidation of the way in which it comes about that the *ego*

sharply bounded off from the outside world appropriates something of the latter to itself. But since we demand not a speculative but an empirical psychology, we may not treat as facts the results of speculation. We must become clear upon the fact, that we cannot prove empirically the bringing of the 'outer' into the 'inner' world. If any one for the sake of some metaphysical theory wishes to assume that such a transformation may take place, he is naturally free to do so, but so far as we are concerned, we shall not make use of this assumption. The more so, as in the light of recent criticism the philosophical justification for such a course seems more than doubtful.[1]

Reflective knowledge must, therefore, be considered as a *content of knowledge*, which is produced through the relation between the *ego* and its affairs or thoughts, and which is accompanied by the specific organic feeling of thought or perception, together with the feeling of appropriation, which is a modification of the feeling of motion.

Apperception as the Production of Knowledge Through the Impact of Two Groups of Representations.

Apperception, as understood by the Herbartian school, may, in contrast to knowledge, through reflection, be defined as follows: Reflective knowledge is an event, where any conscious content of knowledge comes into contact with the consciousness of self, whereas apperception in its third signification is only the first part of this act. Only the act of the production of knowledge was investigated by Herbart. Every knowledge may, in the moment of its formation be divided into two parts: a new content of knowledge, and the determination of the same through previously acquired knowledge.[2]

This fact Herbart interprets from his speculative standpoint as the motion and impact of two different groups of representations of which the newer group awakes and is modified by the older group. To-day, when the belief in the eternal existence

[1] Reference may here be made to Schuppe's *Erkentnisstheoretische Logik*, R. Avenarius, *Weltbegriff*. E. Mach's *Zur Analyse der Empfindungen*.

[2] Wundt expressed nearly the same idea, when he declared that every cognition is at the same time a recognition.

of representations is no longer seriously maintained, such an hypothesis is no longer permissible. But the fact, which forms the basis of Herbart's theory remains. It is possible to prove both experimentally and by the aid of comparative philology, that with every act of knowledge there takes place either a combination of new with already existing values (namely a recognition in a certain limited sense of this word), or a grouping of new values within a class whose value has been previously known. Generally speaking, it may be said that an entirely new value cannot possibly form an object of knowledge until by means of frequent repetition of this value a new habit has been formed. Every act of consciousness be it single or composed of a chain of thought is always a process of reducing the unknown to the known. If, therefore, recognition does not take place immediately, the chain of thought will not be finished[1] until there is found a value which is equal or similar to or contained in the new value. If now this possibility is absent two others are at hand.[2]

In the normal development of a chain of thought the individual, after sufficient time, will form a new habit of thought. The chain of thought is in this case closed through a repetition of the originally given value but with a totally different quality of feeling. The 'unknown,' with its negative characteristics, disappears in presence of the feeling of the 'known.' A new habit of thought has been formed.

The other possibility is where the development of the chain of thought does not occur in a regular way. The interest of the thinking individual becomes transported from the original value to some other value and the former is characterized as 'without importance.'

The determination of every act of knowledge through knowledge previously acquired is effected not only for the general character of the representations but for every element and quality of feeling of such representations. Every new experience must be considered *only as a variation* of previously ac-

[1] It may of course happen that the chain of thought will be uninterrupted, but this will take place usually only in cases that have no great importance for the thinking individual.

[2] I follow here Avenarius: *Kritik der reinen Erfahrung* p. 292, II.

quired knowledge. It need not be mentioned that these relations in the psychical world have their basis in the formation of the central nervous system of the thinking individual. The nervous system, constructed in a certain definite way, permits the existence of only certain definite physiological functions and these have as their correlates only definite psychological values.

Summary.

If now we sum up the results of our analysis of apperception in the three different significations of this conception, we find that these different significations are not false conceptions of the notion, but a use of the same nomenclature for three different phenomena. In addition, apperception in the first meaning of this word and also in the meaning of the Herbartian school are partial phenomena which can be excluded from no act of knowledge. Apperception as reflective knowledge may arise, but does not of necessity arise with every act of knowledge.

If now the question arises to which of these three different phenomena the name apperception most properly belongs, it seems to us that the phenomena of reflective knowledge may most rightfully lay claim to this title. Clearness is covered, or at least should be covered by the word consciousness. To apperception, considered as an act of knowledge, produced by the impact of two groups of representations must be given a meaning entirely different from the meaning used by the Herbartian school, since the movement of representation is entirely non-existent, there being only a determination of every new act of knowledge through the mass of previously acquired knowledge. Thus reflective knowledge remains a special content of knowledge, which is of particular importance for the formation of the psychical personality. The historical sanction for this use of the word apperception was given by Kant, who often describes it as 'the representation of the self.' But if we are to meet the demands of modern psychology, we must avoid all excursions into the domain of transcendentalism, and endeavor to deal with the notion of apperception as an empirical one, which must be treated according to empirical methods.

TYPES OF IMAGINATION.

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In order to make any accurate determination of one's imaginative thought material, it is essential to define what is meant by 'forms of imagination,' 'mind-stuff,' 'symbols in consciousness,' etc. That the memory actually possesses a vast store of images corresponding to every sense, and representations of all the varied movements possible to the organism, there can be no doubt; otherwise it would be impossible to recognize any impression, or execute any movement. In terms of physiological psychology, this simply means that certain permanent modifications of the central nervous organs have taken place, and does not involve the implication that all these images be present to consciousness, or become genuine *mental* factors. Images of every sort, in this general sense, are possessed by every individual, but each mind chooses out of this varied stock of presentations those of one or more senses, which serve it exclusively as symbols for the embodiment of a large part of its thought. It is in this last sense that a person is called a 'visualist,' or a 'tactualist.' The images with which we are concerned are a part of the conscious life of the mind, and can be called up voluntarily. Memory images here treated of as forms of imagination may be defined: 'the appearance in consciousness, under voluntary control, of images without any sensory stimulus.' For example, A may be an exclusive visualist. A certain idea may come to him through hearing; as the sounds strike his ear they are recognized by the memory, and their meaning attaches to them, but they are at once translated in consciousness into visual images, the exclusive form of his representative thought. Although auditory images were awakened, the idea is not stored in the accessible memory as auditory. Now the idea present to A in visual imagery may act as a cue to call up motor images of

the vocal organs; not necessarily however—as Baldwin has pointed out—through kinæsthetic images present to consciousness. Thus, while this idea has called up successively with A, auditory, visual and motor images, and while the auditory images, on direct sense stimulation, and the motor images, on a visual cue, may have been momentarily present to consciousness, it is not necessary that they be so present, and their momentary presence so conditioned does not affect the fact that A's imagination is exclusively visual.

No doubt but few images of the normal individual are strictly of any one type. Though the predominant factor in any one image called into consciousness can usually be determined, the image is nearly always tinged or enlarged by other elements. Sometimes the subordinate image factor, for example motor—visual predominating—is called up by the predominant image factor as a cue, sometimes the subordinate element is an essential of the whole image and appears as a part of it.

In order to determine the important point of the imaginative type of the individual, Professor Jastrow suggests in the *Popular Science Monthly* of September, 1888, an objective method for determining the 'internal language' of the person. His rules follow:

(1) Determine the limit of the capacity of both hearing and sight for receiving impressions.

(2) Determine the amount of error, and the nature of error of each sense.

(3) Determine which of the two processes of perception carried on simultaneously makes the greater impression.

From these united tests he would determine the type of imagination as to whether it be visual or auditory. For motor and tactile he has no complete method, and seems to think that they are nearly always combined with visual or auditory images, since motions are nearly always under the guidance of the eye or ear. But because the motion is always under a guidance it does not follow that the image need be inseparable from the visual images; indeed many of our movements always conducted with the aid of the eye are possible without it, *e. g.*, piano playing and writing. And it may be just as important to treat mo-

tor images apart, though they are usually associated with other sorts, as it is to treat auditory images apart, which with the most of us always occur with visual.

While such a method of determination would no doubt be valuable to the individual, as determining his best method of perceiving, *i. e.*, *receiving* things, it does not at all follow that this may be a basis for a psychological determination of his type of imagination. There is no doubt some general correspondence between the large part which some of our senses play in experience and the predominance of their images in imagination, but it is also certain that the connection is not invariable—witness the anomalous 'tactualists,' 'motiles,' and even 'olfactaires.' It must be true in any case, whatever the predominant type of imagination, that the individual gains most of his ideas through sight and hearing, and it is certain that he will have facility in receiving impressions through those senses, but the relative ease with which he uses hearing or sight may be as well the result of an original idiosyncrasy as of his type of imagination.

In determining a person's type of imagination, it is rather the sense images which he uses in *expressing* his ideas, and the sense-images to which he *appeals* in another person, which are to be looked to as an objective clue to his mind stuff than the images used in receiving ideas. Professor Jastrow himself mentions the possibility of image translation, and Wilbrand has determined in a case of aphasia that the brain area concerned in visual reception is not identical with the area concerned in memories of visual images. E. A. Kirkpatrick, in an article in THE PSYCHOLOGICAL REVIEW, notes how prone school children, upon whom he was making memory experiments, were to translate presentation forms into other forms. With children the process often shows to the observer by their murmuring words to themselves which are presented written, counting out numbers given orally on their fingers, etc. In adults, it is not often that the images substituted in the mind are allowed to picture themselves forth in movements.

In the studies from the Harvard Psych. Lab. given in THE PSYCHOLOGICAL REVIEW, a report is given of an investigation on

memory, in which a similar method was used, but for a somewhat different purpose. The object seems to have been to arrive at general conclusions concerning the memory, and not to investigate the type of the individual, but some of the conclusions reached bear upon the subject in hand. The method consisted in the presentation of simple visible and audible contents under varying conditions. The things chosen were numbers and colors. Extended experiments were made with five subjects. Two of the conclusions drawn are:

(1) When two senses act together in recollection they hinder each other.

(2) When isolated, visual memory surpasses by far aural; when combined, the aural excels the visual, with one exception.

If these five men were average types, these results are of some importance as determining the sort of presentation best used, but in each case the statement of the conclusion reached is false. The statements should read:

(1) When two senses act together *in presentation*, recollection is hindered.

(2) The memory of *isolated visual presentations* surpasses by far the memory of *isolated aural presentations*. When visual and aural presentations are combined, the aural are best remembered. (One exception.)

There may be a great difference between 'visual memory' and memory of visual presentations. Moreover, the presence of one exception in the second conclusion quoted is not very reassuring. An exception of 20 per cent. is rather large, especially when only five cases, however accurately determined, are under consideration. The material used in presentation is peculiarly liable to mental translation. Many of us remember a series of numbers presented through the ear by images of the vocal organs (motor). About 45 out of a 100 people examined in a given case reported a visual scheme for numbers. Judging from that, two of the five subjects may have remembered their numbers by the aid of such schemes.

If it were not open to objection, such an experimental method of investigating an individual's type of imagination would be the

best. It gives definite results and has the charm of being a laboratory method, but it seems obvious that no presentation method can avail for the determination of the predominant memory images. The only objective method capable of giving exact results would seem to be the examination and classification of cases of aphasia. These are comparatively rare, and the evidence is so fragmentary in each single case, that only the most general conclusions can be drawn.

Introspection has as many disadvantages in this field, as elsewhere, but coupled with such objective determinations as seem to give legitimate clues, perhaps its results may be worth examination.

A list of test questions was submitted to a class of 100 college juniors who had enough knowledge of the subject to understand what was wanted but who were not biased by any preconceptions.

(1) Observe dreams for some time and report as to the relative prevalence of the sorts of images. (While many dreams, perhaps even all, are suggested by sense-stimuli always present to sight, hearing, and touch, in sleep, it is still true that the paths of association awakened by such sensations will probably be those most frequently used, whether the occasioning disturbance be extra-cranial or not).

(2) Give general method of recall in recitation, conversation, etc., as well as possible. A special report was secured as to method of recalling the forgotten name of a person. (This gives some clue as to visual images of person or name, or auditory images of person's voice or sound of name, or vocal-motor images of pronunciation of name.)

(3) *a* As to memory of breakfast table; were objects colored? (referred to Galton's experiment mentioned in James' *Briefer Course.*)

b As to schemes, visual or otherwise, for numbers, colors, days of week, months, or any other series schematized in imagination. With any clues as to the origin of these schemes.

(4) *a* As to method of recalling a piece of music (auditory, visual or motor).

b As to which is best remembered in music first heard; rhythm (motor) or melody (auditory with perhaps vocal motor).

c As to whether a melody remembered is recalled with a tone color, or merely as abstract melody.

d As to whether images are called up in listening to music, and of what sort.

(5) *a* As to the possibility of conceiving bubble and toddle with open lips and passive tongue.

b As to presence of suppressed articulation in reading.

c As to how concept *riding-a-wheel* is conceived. (At least three-fourths of class had ridden wheels.) These will give some clue as to the presence of motor images.

(6) As to presence of images for concepts: Relation, cause-and-effect, classification. (This may show tendency to image abstracts and also the presence of visual and motor images.)

(7) As to any change in the type of imagination which may have occurred.

(8) State conclusion as to which type the individual thinks predominates. What sorts were second and third, and if all the sorts of imagery were present.

Where unusual types were reported, (auditory, motor, tactile,) as predominating this list was supplemented by a second, bearing on that especial sort.

Of 100 cases reported, 82 were from their own conclusions and other data judged to be predominantly visual, 6 auditory, 4 motor, 1 tactual; 5 from their own conclusions, corroborated by their reports were equally visualists and 'audiles'; 2 were equally visualists and 'motiles.'

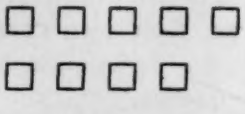
The auditory constituted a large element in 20, the motor in 10, the tactual in 4.

None lacked visual or auditory images, though one considered the auditory doubtful. One lacked motor images, 3 lacked tactual images, some 4 of the class, age 19–24, were without much imagery.

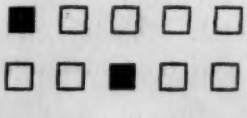
Serial schemes for numbers, etc., were usually confined to the visualists, though with some exceptions. 41 reported

schemes for numbers, letters of alphabet, days of week, etc. As a rule, where one common series was schematized, others were. In 12 cases the origin of the scheme was reported. Appearance of a page where first learned is usually the orgin of alphabet schemes, also often of number schemes. Many number schemes, whose form in detail cannot be accounted for, have breaks or sharp turns at six, eight, twelve and twenty, probably marking the successive stages at which numbers up to that point exclusively were dealt with in their early school work. Days-of-week schemes often show traces of calendars. The very common circular arrangement of the months is probably due to vague associations with the zodiac and the earth's revolution; several reported this definitely. Of course, the circle is a very convenient symbol for a series returning upon itself, but there is no reason why the days of the week be not so arranged as well as the months. The majority of number schemes reported rise from right to left; there is nearly always a break at twenty, and the scheme usually does not extend beyond one hundred. Usually days of the week rise from Sunday to some point in the middle of the week and then slope down to a second Sunday.

One of the most interesting schemes reported shows a remarkable power of visualizing. Numbers, days of week, years in century, and even days of month are represented by regular rows of five squares placed beneath each other. If the number does not fill out a row, a corresponding blank is left. Thus nine is represented by:



Days of the week and month run on in same order, Sunday being a dark square:



This scheme is thought to have been derived from a calendar:

Auditory images are usually of words or music where the images play a large part in thinking. In either case, as James points out, it is easy to mistake a motor image of the vocal organs for a recall of the *sound*. Often unnoticed vocal-motor images serve as the necessary cue to the recall of a strain of music or of the sound of a passage read. The motor element is so easily overlooked that probably not a few who think that the auditory plays a large element in their imagination would find the real element motor. Even in memory of music where it would be expected that auditory images would greatly predominate, the reports seem to bear this out. Of 83 reporting as to how they recalled a memorized piece of music, 25 reported, by auditory, 23 by tactile and motor, and 35 by visual images.

The true 'audile' in reading often hears the words as though in the head or even in the eyes, but not in the throat.

Motor images seem from the reports to be a much more important element in imagination than is usually assumed. Of the abstract concepts, cause-and-effect and classification, which at least one-half of the class image, the first was nearly always reported as containing a motor element, usually coupled with a visual, and the second, 'classification,' was also motor in coloring in a majority of the images reported. It seems but natural that the transitive states should be pictured in memory by motor images, as the very name 'transitive' indicates. The difficulty of distinguishing auditory and motor images has already been noted. In an equal number of cases, rhythm was better remembered than melody. It would seem as though any recall of rhythm must necessarily be motor. The number of cases in which a piece of music is recalled by auditory images, 25, is but little larger than the number of cases in which the recall was by motor and tactile, 23. The deaf Beethoven, writing grand compositions, has been cited as a remarkable instance of auditory imagination; but the same deaf Beethoven, working out those compositions at the piano he could not hear, and extemporizing on stringed instruments he could not tune, shows the importance even to him, master of tones, of motor and tactual experiences in the expression of ideas.

Not a few of our concepts of motions are symbolized in

motor images. In a large number of cases, 'riding-a-wheel' was represented by a distinct feeling of motion in the legs, or of the whole body in mounting. About 60 of 100 reported suppressed articulation in all reading. No doubt many of our gestures are the results of motor forms of imagination. To be sure, many gestures, especially expressions of emotion, are spontaneous and preceded in consciousness by no motor image which they realize; but it is not difficult to distinguish such gestures from those which do delineate motor images. The latter are conscious, under control of the will, and are often felt as giving expression to motor impulses. Witness the man who shapes his thought in his hands as he speaks, who has a definite feeling, located in his hands, that in a logical train of thought one thought *draws* another after it. Probably motor and tactile images are of great importance in imagining emotional states. In some cases the thought of the cause of the emotion will call up a faint repetition of the bodily state, but often this does not or cannot happen, and if the emotion is recalled at all it must be by the aid of motor and tactile images of those states.

To a person whose imagination is largely motor, many conceptions cannot be grasped without this motor element. It seems the very life of the notion. Power, sublimity, life, are such concepts. None of the persons reporting as 'motiles' could conceive of a personification without involving a motor element. To many a person in his ordinary thought, it is this motor element which distinguishes the beautiful from the sublime; it is his way of representing power and might. One person in the class, who cannot conceive what a motor image would be like, never appreciates any personification, or has the slightest tendency to personify; although interested in oratory, he has no tendency to gesture.

A motor element is involved in many of the schemes reported for months and days of week. Climbing up hill during winter months or early part of week, and going down during summer months, or last of week. In the case of the days of the week, the scheme with the hill in the middle, rarely toward end, was formed during the college course, when the press of work is greatest at mid-week.

Aesthetic enjoyment is largely conditioned by motor and tactile imagery. One of the chief demands in modern painting and sculpture is action, *i. e.*, the capability of immobile things to rouse motor imagery. Fromentin's Arab Falconer would be sorry sight if it only roused visual associations; but the distorted drawing and the grand swing of the uplifted arm suggest motor images of mad, dashing energy and fierce, free muscular life. We participate in the mad galop of the steed and sympathize with the rider because 'we picture to ourselves how it feels,' *i. e.*, we call up motor and tactual images. It is delightful to poise in imagination with a sculptured Mercury, or to share for a few moments the brawny firmness of some bronze hero. Even in poetry and music we *feel* the wild galop suggested by the rhythm of Browning's 'How They Brought the Good News from Ghent,' or of Schubert's 'Erlkönig.' Lotze makes our enjoyment in watching many forms of animal life, and in viewing many pictures, to consist in an ability to imagine how we should feel in their places; we get a joy out of the swift flight of the swallow or the petty industry of the ant, because we live over again to ourselves what we imagine their life to be. No doubt our representations are far enough from the reality, but they must consist in more or less vivid motor and tactile images with the possible accompaniment of other sorts. Architecture, at first glance, is thought of as appealing only to the eye; but if this were the case, we should not have a sense of unreality and disappointment in finding what seemed an imposing marble temple at a little distance to be but framework and stucco. A part of the interest in architecture comes in imagining the vast load borne up by the aspiring under-structure. If architecture be 'frozen music,' this inter-play and combination of opposing forces respresents the rhythm. To most of us it is essentially a matter of motor representation. We get a vivid example of this when at the foot of a perpendicular cliff or towering edifice, we have the sense of its pressing down upon us, overhanging and about to crush us.

Tactual images are agreed by all to play the slightest rôle in imagination. They are oftenest entirely lacking. A single case of tactual images predominating was reported among the

hundred examined. In this case, general concepts are not imaged in any way. Dreams are almost exclusively tactual. It would be hard to imagine a tactual scheme for numbers, yet this man's imagination solves the problem easily enough. His number scheme consists of the representation of the series of sensations produced by tapping the tips of the fingers of the right hand successively upon a surface. Thus sensation at tip of little finger corresponds to '5' and its tens, sensation at tip of thumb—second round—for '6' and its tens, etc. Scheme was formed while learning the multiplication table by counting on his fingers.

Little was reported as to any remembered change in types of imagination. Two people of unusual types, tactile and motile, report that the visual is increasing. Four report a recent increase of auditory images; the increase was referred to attention to music, if any reason was given. In no case was there a tendency to increase of imagery. Five report a decrease. The members of class, of course, were not old enough to furnish any examples of the decided decrease toward middle age of the image-tendency noted by James and others.

It is hard to obtain data as to the imagination of children and illiterate persons, so that the effect of education on the imagination is largely a matter of speculation. It seems quite probable that in the early childhood of the individual and the race all sorts of impressions are stored in the memory and recalled. Voluntary attention does not then determine the trend of the imagination, and to the child, auditory, motor, tactile and even gustatory images would seem to have as good a right to be remembered as the visual. Inherited tendencies in the neural tracts may have something to do with the result, but aside from that, it is very probable that early life is characterized by a much larger variety of images and a more exclusive use of them than later life. There is little doubt that motor images have a full share in the imagination of the child and the savage. Vocabularies of infant speech, as usually given with a large percentage of substantives and a small percentage of verbs, would not seem to bear this out, but Professor Dewey, in an article in THE PSYCHOLOGICAL REVIEW (v. I., p. 63), calls attention to a common error in compiling such vo-

cabularies. He shows that the young child uses words with little or no feeling for a fixed part-of-speech significance, and that the same word may be noun, verb and adjective. He emphasizes the large percentage of verbs actually to be found in a child's speech. Among savages, the universal tendency to descriptive gesture and sign language attests the motor element in the primitive imagination. From a utilitarian standpoint, motor images are quite as important as visual to either the savage or the child. Movement constitutes a large part of the life of either. Baldwin states that in the growth of language-memory, the auditory and visual memories must get the start of the motor memory, though later the adult becomes vocal-motor. No doubt, a large part of the imagery of the adult—especially if 'audile' or 'motile'—consists of images of words, but there is no reason why the mind-stuff of a child should not be largely motor before the development of motor speech. With the adult, much of image-thought is not by word-symbols of any sort; words at best can usually mark only the distinct, substantive parts. The transitive and the vague upon which James lays so much stress can seldom be expressed in words, and may very well, in both child and adult, be symboled in consciousness by motor-tinged imagery. Even distinct concepts are not always represented by words; we are constantly making new concepts, unnamed, which we represent in thought by some convenient sign and use for the time being. The child who knows but a few words, visual, auditory, or motor, but who thinks a multitude of actions and things, must be dependent in much of his thought on wordless representative imagery.

Perhaps in early child life, all sense presentations are remembered equally well, but later the superior expressiveness of sight, and the fact that it is so largely used in all our processes of education, leads the mind to devote its chief attention to that form of memory. Gradually voluntary control of the auditory, motor, tactual, gustatory, and olfactory memories becomes less and less—degree varying with the individual—or is entirely lost. Some original structural peculiarity of the central organs may account for unusual types. There is no doubt that attention to a single sense tends to develop memory images of that

sort. Among the few changes in type of imagination noted in the reports mentioned above, several had increased their auditory memory by the study of music, and a tactualist reported himself as constantly becoming more visual.

It almost goes without saying that the mental life of lower orders is limited by the definiteness and variety of images possible to them. The senses limit their thought. The world to the earth-worm must be a matter of tactual and motor images.

The image-tendency seems to reach its culmination in the early life of the adult, along with the æsthetic and emotional impulses. In middle life, the use of symbols, even visual, grows less and less, and often fades out altogether. That Galton's older, scientific men visualized less than younger, more insignificant men need not be due to any incompatability between scientific generalization and imagery; it is probably due to their being *older* men. Descriptive science is greatly aided by visualization. The reason that old men dwell so much on their earlier life, and disregard their middle age may be that those early memories are still connected with image associations. The work of middle-life has no such corresponding series of pictures. They live over their early childhood and youth because they can *live* it over again in imagination.

Perhaps the difference between men and women, which Lotze characterizes as a tendency of men to regard the mechanical and of women to regard the ideal, may be due to education. The life and education of the girl emphasizes the visual and auditory in their more delicate forms. The boy, on the other hand, has a far greater opportunity for the acquisition of motor images and impulses. He has a contempt for a girl who may know how a thing *looks* or *sounds* but who doesn't know how it *works*.

Imaging has many disadvantages. It is often a positive hindrance, *e. g.*, motor images in reading, visual number-schemes in calculation. It often leads to a narrow view, if the type is exclusive, and the symbol is taken for the reality. Some one has pointed out the vice of visualization as the basis of the philosophies of Locke, Berkeley and Hume. Much of the feeling and expression of other men must be lost to the person with

a pure type of imagination. Most men possess enough of the common types, though subordinated to the ever-present visual, to enable them to call up on suggestion the image present to another.

But there are also advantages. Facility in image-thinking must enhance æsthetic appreciation, if it is not essential to it. For the development of details in dynamic science, gestures in oratory, figures in writing, and for the appreciation of all forms of art, an imagination richly stocked is of great value. True enough, as James remarks, bare concepts do just as well as colored images in running the ordinary affairs of life. But bare concepts are meager material with which to enjoy in memory a favorite picture, bring back a bit of music or a dear face, live over again a deep emotion.

ON INDIVIDUAL SENSIBILITY TO PAIN.[1]

BY DR. HAROLD GRIFFING.

The relative sensibility of individuals to pain is a problem of practical as well as theoretical interest. A more definite knowledge of the subject might be utilized not only in medicine but also in education. The data obtained are, however, quite limited; and most of the observations published have been made by anthropologists with but little consideration of the sources of error involved. The experiments here reported were undertaken with a view to throwing light on these sources of error rather than for statistical purposes.

The tests were made with Professor Cattell's pressure algometer and with the induction coil. The algometer registered the pressure exerted up to 15 kilo. It was applied by me on the palm of the hand and the forehead in most of the experiments; but in some, the latter ones, the observer applied the pressure himself, and the fleshy part of the thumb was used instead of the palm of the hand. The pressure was increased slowly at a rate as constant as practicable until the sensation became uncomfortable.

In the electrical tests the two forefingers of each hand were placed in separate cups of water and the alternating current was sent through the body from hand to hand. Four gravity cells were used with an induction coil. The distance of the primary coil from the secondary served as a rough indicator of the electromotive force of the current, which may be taken to represent the intensity of the stimulus.

The purpose of the first group of experiments was principally to find whether the sensibility of a sense organ might not be determined, in whole or in part, by the degree of protection given by other tissues. If decreased sensibility to pain may be due to the thickness of the skin, the determination of the dermal threshold for pain tells us nothing of a person's general sensibility to

[1] From the Psychological Laboratory of Columbia University.

pain. In order to investigate this source of error, before making the test with the algometer, I recorded my judgment of the probable result from the appearance of the hand. This was done on fifty-three students, four tests being made on each person, two on each hand. The men were marked *a*, *b*, *c* or *d*, according to their estimated sensibility. I give below the resulting average values of the pain threshold in kilograms, with the maxima and minima. The results are given in two groups, I. and II., since in group II., the observer applied the stimulus to the thumb, whereas in I., I applied it myself to the palm. Some of the tests in II. were kindly made for me by advanced students in the Columbia Psychological Laboratory in connection with other independent tests.

TABLE I.

NUMBER.		EST. SENS'Y.	AVGE. T.		MAX. T.		MIN. T.	
I.	II.	○	I.	II.	I.	II.	I.	II.
I.	6	A		5.1		8.2		2.1
19	10	B	10.0	6.9	13.8	15+	4.0	4.0
11	3	C	12.4	13.7	15+	15+	7.1	9.4
4		D	14.4		15+		13.7	

First vertical column gives number of observers; the second gives the estimated sensibility, the others the average and maximum and minimum values of the pain threshold (T).

From the results above given it is evident that, as might be expected, the thickness of the skin and subcutaneous tissues is an important element in determining the threshold for dermal pain. It is not, however, the only element involved. Some observers were much more sensitive and others less sensitive than one might expect from the appearance of the hand.

If the protection given by the tissues varies with individuals, then the relative sensibility of different parts of the body will presumably also be subject to individual variations. This I found to be true. Those having a high pain threshold for the hand were not always correspondingly sensitive to pressure applied to the forehead and top of the head.

Nevertheless, as will be seen by the following table, those who were sensitive on the hand were on the average more sen-

sitive on the head. I give now the average values, with maximum and minima, of the pain threshold for the head, for the different sets rated according to the value of their hand threshold. The first half of the table is for the men classed group I. in the previous table, and the second is for those classed in group II. The top of the head was used with group II., the forehead for group I.

TABLE II.

NUMBER.	T. FOR HAND.	T. FOR HEAD.	MAX.	MIN.
12	Over 13	6.5	13.4	3.2
15	10 to 13	5.0	5.7	3.4
12	Under 10	3.5	4.6	1.5
3	Over 10	7.0	11.5	4.8
6	6 to 10	2.3	3.5	1.1
14	Under 6	1.9	5.1	1.0

The first vertical column gives number of observers.

The second vertical column gives threshhold values for three groups in order of sensibility.

The third, fourth, and fifth columns give average threshhold and maximum and minimum values for observers mentioned in second column.

It has generally been assumed that the sensibility to one form of painful stimulation may serve as an index to pain sensibility in general. But there is no evidence for such an assumption. In order to obtain data on the subject, I tested 27 observers with the induction coil as well as with the pressure algometer. In this way I found that the sensibility to electrical stimulation to be quite independent of pressure sensibility. Three observers, among the most sensitive to pressure on the hand and head declare, that they felt no discomfort at all when the maximum strength of current was given. One of these did not 'feel' the current when six cells were used instead of four, although the muscles of his fingers contracted from the stimulation of the current. On the other hand one student to whom a pressure of 15+ kilo. on the hand and 11 kilo. on the head, gave no discomfort, considered the electrical effect unpleasant when the current was of the average strength.

The above experiments do not, however, prove that the pain sensibility of the nervous system to different forms of stimu-

lation is not the same. We can only conclude that the pain sensibility to sensory stimulation varies with the conditions of stimulation. Not knowing the path of the current in the body, we have no right to assume any special physiological or psychological basis for the data obtained from introspection.

The probable fact that in the pressure experiments, the variations cannot all be explained by the thickness of the skin and similar conditions, goes to show that there is such a thing as general sensibility to pain; and the general correspondence of the results for different places of stimulation may be interpreted in the same way. But even these results may be due to peripheral causes, and not to any property of the central nervous system, or of the consciousness by which it is accompanied.

THE THIRD YEAR AT THE YALE LABORATORY.

BY E. W. SCRIPTURE,

Yale University.

The report is taken up from the point at which it was left in THE PSYCHOLOGICAL REVIEW, 1895, II., 379.

The investigation of hallucination and suggestion by C. E. Seashore was continued throughout the third year and was brought to a close in May, 1895. The first section of this investigation concerned the suggestive influence of size on judgments of weight. Two sets of blocks were used. Set A varied in size, but had a uniform weight, while set B varied in weight, but had a uniform size. The problem was to pick out that block of set B which appeared of the same weight as a given block from set A. The difference thus made between the estimated weight of an A block and its true weight, gave the effect of the suggestive influence due to the difference in size. The experiments, carried out with the greatest care, gave a definite suggestive influence for each difference in size. The law governing the results is shown in Fig. 1. The investigation was extended to the various forms under which size shows its influ-

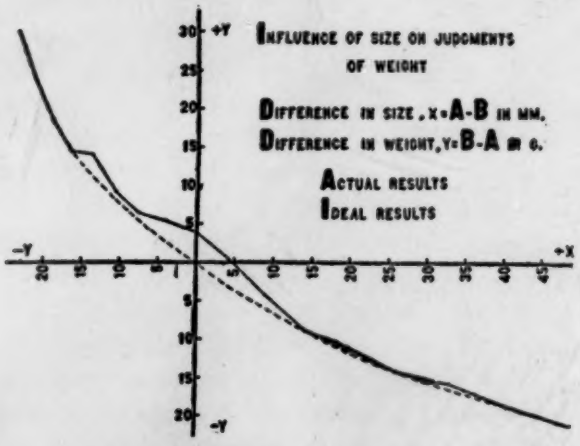


FIG. 1.

ence, *e. g.*, with the blocks indirectly seen, or seen and then hidden, or estimated by muscle-sense, or by touch, etc. The results are shown in figures 2 and 3.

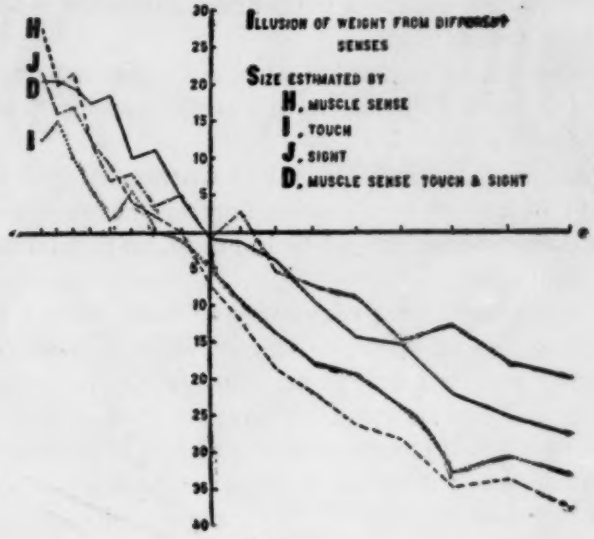


FIG. 2.

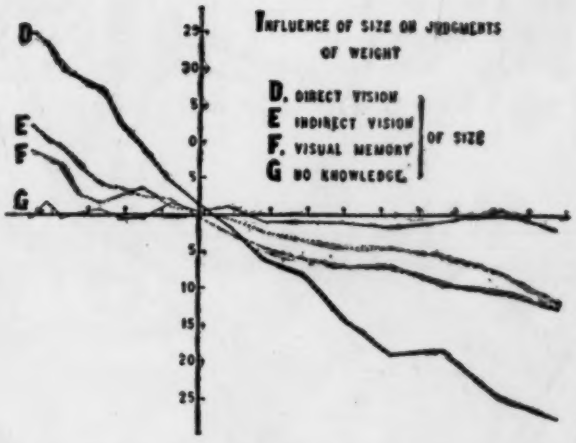


FIG. 3.

The next section investigated hallucinations of warmth. It was found that with an appropriate suggestion, a pure hallucination of heat could be regularly produced.

A third section investigated the effect of expectation and suggestion on the least perceptible differences in lights. It was found that the repetition of a number of experiments was sufficient to regularly create a perceptible difference when absolutely no difference existed.

A fourth section showed that expectation was sufficient to create a perceptible continuous change in the intensity of an illuminated disc.

In a fifth section hallucinations of a non-existing object were produced; in a sixth, of a non-existing tone; and, in a seventh, of non-existing sensations of touch, taste, smell and electrical stimulation.

In every case the experiments were quantitative; the scale was more or less an arbitrary one, but always admitted reduction to some standard unit of energy. Thus, on the principle that the intensity of an hallucination is the same as that of a sensation from which it cannot be distinguished, the intensity of the hallucination was measured in terms of the physical stimulus.

It is to be added that all these experiments were made on normal, healthy, unsuspecting individuals.

The second extended investigation was by John M. Moore on the subject of fatigue. In the first place the two eyes were fatigued by being required to estimate depths. The subject looking through a slit at G (fig. 4), had to adjust the bead B

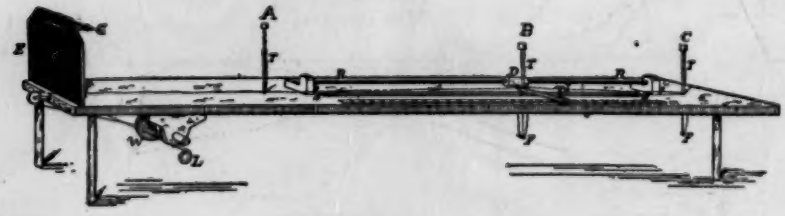


FIG. 4.

midway between the beads A and C, while seeing only one at a time. This middle bead B was placed always beyond the true middle, the error increasing with fatigue.

The experiment was repeated forty times in succession. The average amount by which the successive experiments in-

creased the error of the first one is shown for one observer in Fig. 5.

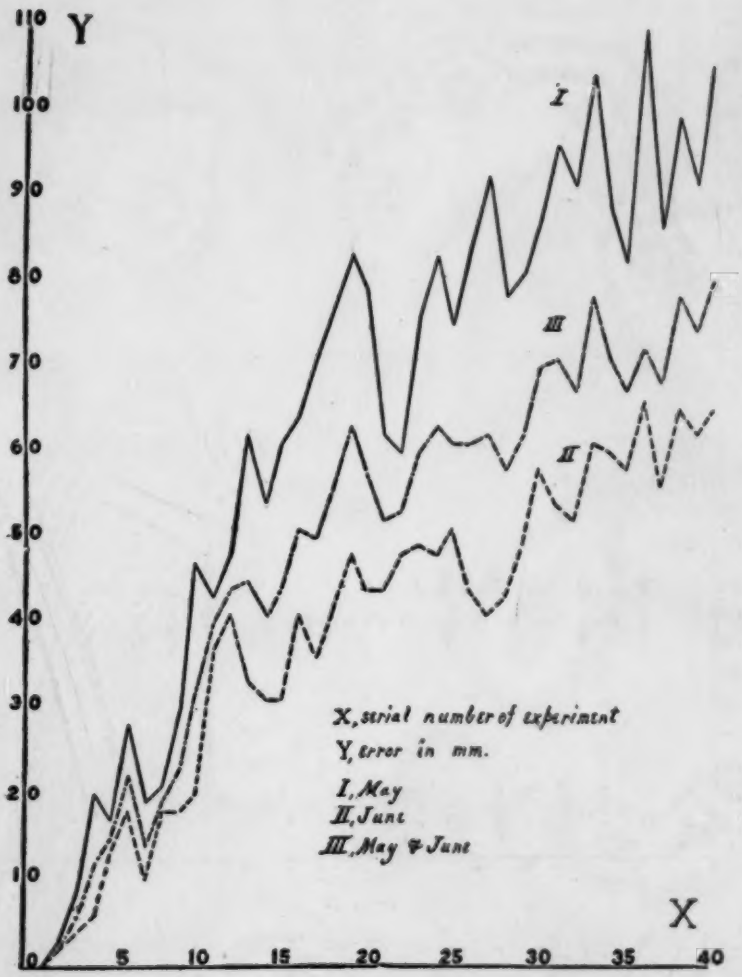


FIG. 5.

The investigation then proceeded to test one eye instead of two. Similar but less steep curves of fatigue were found. Thereafter the curve of fatigue was determined for steadily

repeated accommodations of the eye with results as shown in Fig. 6. Finally the effect of fatigue on rapidly repeated taps

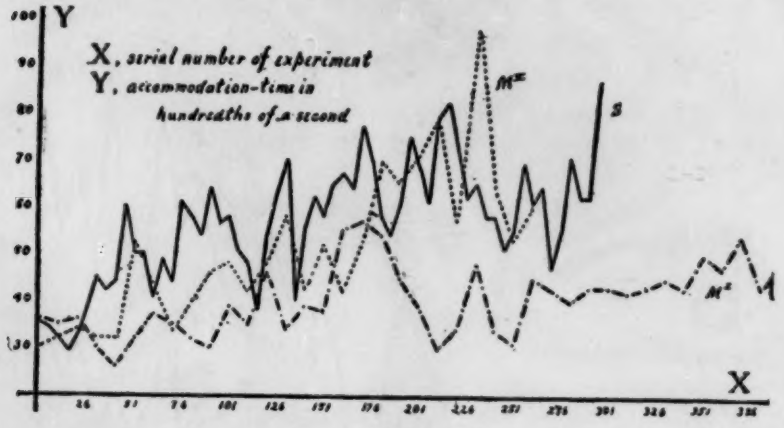


FIG. 6.

was determined. The general course of fatigue in this case is shown in Fig. 7.

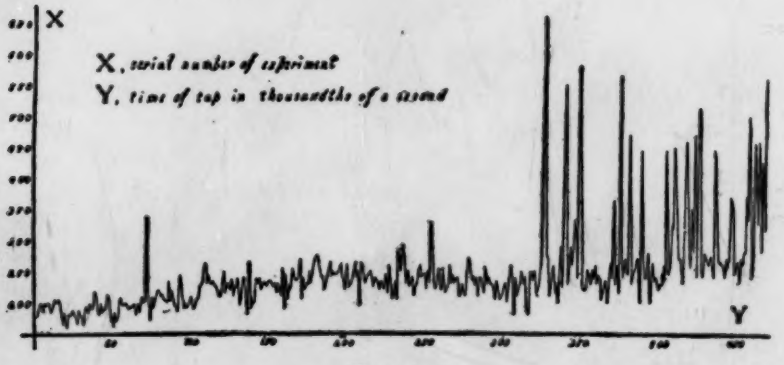


FIG. 7.

These two investigations were presented and accepted for the degree of Ph. D., making four such theses in three years.

Edward M. Weyer succeeded in measuring the reaction time of a dog finding it to be an average of 89σ. A method of measuring the dog's time of thought was devised with great labor; owing, however, to difficulties with the spark records, no definite conclusion was reached on this point.

The activity of the workshop was greater than ever, thirty or forty new instruments having been invented and constructed. Among them are to be found the pendulum chronoscope, the standard drum for very accurate measurements of time, the electric color-wheel with speed indicator, etc.

The results of the completed investigations were published in the *Studies from the Yale Psychological Laboratory*, 1895.

The officers of the laboratory were E. W. Scripture, instructor and director, and J. Allen Gilbert, assistant. Dr. Gilbert left at the end of the year to take the place of assistant professor in the University of Iowa.

DISCUSSION AND REPORTS.

A PSYCHOLOGICAL INTERPRETATION OF CERTAIN DOCTRINES IN FORMAL LOGIC.[1]

The tendency of the later modern logic has certainly been to free the account of the thought process from its limitations to grammatical forms and analogies. The extent to which logic has suffered from the bondage of grammar can hardly be overstated. Mere differences in the mother-tongues have been at the bottom of many of the disagreements between French and German or between English and French logicians. The rules of the syllogism, although international in their cogency, have done much to keep thought as an object of logical study within its mediæval bounds of word-gymnastics long after the thinkers themselves have left the cloister and its formal abstractions and turned their thinking, their scientific activity, into all phases of experience. Those time-honored rules, useful perhaps in the good old times, have become not altogether appropriate to the sort of thinking that goes on in a modern laboratory, nor are they quite adequate to a game of ball, which is as complete an expression of thought in these times as were the exciting tourneys of long ago with *ante rem*, *post rem* and *in re* for weapons.

The first attempts to free logic from language and grammar were in the different notations devised. The circular notation, for example, accomplished a good deal; and the algebra of logic has reached a high degree of abstraction from grammatical conditions. But logic in recent years has been getting most of its inspiration from psychology. Thus the simple suggestion of such a possibility as an 'unconscious conclusion,' whatever be the objections to the form that the doctrine first took, cannot but have had its lasting effect upon subsequent ideas of conscious conclusions. Logic, it must be admitted, has had rather a thick skull, but for all that the new ideas have made their way in. The 'unconscious conclusion' was one of the ideas that did much to give new life to comparative psychology, and comparative or biological psychology has revolutionized logic at least in one respect. It has materially changed the relation of language to thought. Lan-

[1] Read by title at the meeting of the American Psychological Association, Philadelphia, 1895.

guage, as spoken and written, is to-day regarded as but one part of the medium in which rational experience is expressed or made objective. Similarly the head alone is no longer looked upon as the seat of mind, but only of the brain, which is but a part, albeit, if distinctions must be drawn, an important part of the organism, in which, as a whole, mind resides. Environment in its entirety is the present-day logician's medium of thought.

Some simple evidences of the freedom of logic from grammatical limitations are (1) in the recognized universality and affirmative character of all judgments or rather of all judgment, since to-day we must talk rather of judgment than of judgments; thus you may have negative or particular sentences but neither negative nor particular judgments, and (2) in the notion that judgment is always *both* analytic and synthetic or *both* inductive and deductive. Judgment is, to commit a long compound, an analytico-synthetic tension. Sentences may be explicative and ampliative, analytical and synthetical; but judgment is like impulse; it is one; it is not to be cut up into classes; at the very most it has only manifold aspects or stages; with due caution it can be defined as the particular becoming universal, or the negative becoming affirmative, or the concrete becoming abstract, or quantity becoming quality. Negation, as an incident of judgment, means separation or differentiation, and so is a stage or aspect of organization.

The freed logic of to-day must refuse to treat lightly the mortality of Socrates, or even of Gaius, or the elementary character of that useful metal iron. It has no choice but to say that the statements, 'Socrates is a mortal' and 'Iron is a metal,' are either only sentences and then merely material parts of a total experience or cases of judgment only in so far as they can be said to represent a living present experience, in other words, as their predicates are taken to refer to wholly subjective mental states. The mortality of Socrates was a true judgment, I would suggest, to the Athenians of Socrates' time, to the grieved Chrito or the exultant Anytus, and the elementary character of iron has been a true judgment to some scientists. In a word, judgment is not a statement or a proposition; it is not an expressed relation between two terms or concepts; it is most safely described as the construction of reality or as self-conscious experience of reality, or in so far as present to consciousness as the tension of adjustment, or again as organization. The true predicate of judgment is no word; it is the judging self as distinguished from its object, the not-self or environment or grammatical subject. *A is B* is a judgment only in so far as *B* can be said to be somebody's self-conscious attitude towards *A* or a real subjective experience of *A* or as *B* is the unity of the self

at the particular moment of the A experience. To express the same idea in still another way, keeping, however, the grammatical analogy, the subject of the real judgment is the 'universe of discourse'; the predicate is the speaker or more generally the agent. Again the grammatical subject is the psychological object, the world of experience; the predicate is the self, the psychological subject. Some may say that I am turning things around completely, that the world is the real predicate, and so on, but we may waive that possibility. *In any case a sentence is never the judgment.*

The doctrines in formal logic, the different rules of definition and of the syllogism and the like, appear in quite a new light when environment in its entirety as the real medium of thought and judgment as construction of reality or as organization are taken into account. The doctrines of formal logic make a sort of linguistic or grammatical *projection*, if I may take a metaphor from mathematics, of fluent activity, that is, of fluency in the use of the medium of thought, or again of what in biology is known as habit or accomplished adjustment. Of course projection is always a great disguise. For example, a mirror of complex surface may hide one even from himself. Formal logic projects fluent action or habit upon the plane of language and makes it all but unrecognizable. Moreover no expression of fluent activity is more distorted and disguised by the change than the natural use of language itself.

For evidence of the foregoing let us consider (1) the purely formal copula that logic has insisted upon, (2) the concrete and quantified predicate, (3) the abstraction of time, (4) the definition that must be virtually an equation, and (5) the different rules of distribution. Many other sources of evidence might be cited, but these are the simpler ones. We shall take them up in the order given, although before the review is finished all five will have collapsed into one—which is just what ought to happen.

1. In the real judgment the copula is not a word at all. It is the tension of consciousness, the attention. The copula as a word is a mere name, naming in the sentence in which it is found the fact of a former attention. Moreover, logic's formal copula is never used in living, that is, in natural discourse. As to the real copula, attention, if the tension of consciousness cease, what ensues? It is clear that an act expressing fulfilled adjustment ensues. Logic's formal eviscerated copula, accordingly, with not even the idea of existence left to it, to say nothing of the absence of all time ideas, indicates the passing of tension or—the same thing—the dying of consciousness in action.

2. The predicate as concrete and quantified is equally strange to the real judgment in consciousness. Reduce a judgment to an equation of quantities, and you do in so far make it, or you make so much of your environment as it contains a mechanism—even a sentence is a mechanism—which you are free to use or to act in. Do but recall that we have said that the true predicate in judgment is the self. The quantified predicate, then, is the adjusted self, or, biologically, the adjusted organism. In other words, quantification of the predicate is logic's way of viewing the identification of the self with its environment. Complete quantification makes subject and predicate one, not two. The man holding a sledge-hammer in the air, measuring positions and distances and arranging his own inner states at the same time, shows the conscious judgment, the tension of adjustment, passing into the fulfilled equation. The actual blow is the equation or definition of the experience. In real life we never quantify our predicates; we bring our hammers down instead. Quantification of the predicate, like eviscer-ation of the copula, means action.

3. To the abstraction of time by formal logic some reference was made in what was said about the copula. It may here be added, however, that the timeless or tenseless copula and the quantified predicate go together. As just pointed out, the quantification of the predicate makes equation. An equation of course is timeless. An equation is also always a universal proposition. Even in such a case as *Some A is some B* through the quantification the qualitative difference between A and B is so far overlooked or transcended that the true judgment is rather *All AB is C*. *Some A is some B*, a wholly unnatural form, is but a linguistic projection of a timeless continuous experience AB. The lack of tense only testifies to this continuity. The tenseless copula and quantification in logic answer to the continuously filled time-interval that in psychology is no time to consciousness. In general, quantification, as its contagion spreads to the predicate, and by reaction more precisely measures the subject, shows experience becoming single, or continuous, and so from the standpoint of projection in language robs the copula of tense. The tenseless copula, finally, is evidently part and parcel of the logical distortion of the freed act.

4. To the definition as an equation reference has already been made. I only repeat that the fulfilled timeless equation of quantities is always in the act that proves adjustment.

5. Finally in the syllogistic rules of distribution we have but one more view of the way in which formal logic projects the facts of fluent action upon the medium of language. The rules of distribution

are demands for universality. In the case of the middle term the demand is absolute. But, since universality and tenselessness and freed activity belong together, the familiar rule that the middle term must be distributed only shows that reasoning depends unconditionally upon activity. I would suggest, in order rather to give my general meaning than to say anything at all final, that the fallacy of the undistributed middle represents in projection an unmediated impulse, while the illicit processes of the major and the minor terms represent respectively action under coercion from environment and rash or random action.

But I must conclude. I have said here if I have not shown (1) that environment in its entirety is the real medium of thought, (2) that judgment is, among other descriptions, the tension of adjustment, and (3) that formal logic as a body of doctrine is activity *projected* upon language. I recognize clearly enough that my ideal in this short paper has been better than the execution. If, however, only what I have wanted to do is now evident the labor has not been in vain. Nothing in philosophy is so much needed at the present time as the adjustment of the science of abstract thought to the science of organic action, and every little hint as to how that adjustment can be brought about cannot but be at least a little help. The evolution of consciousness must be almost meaningless until the simplest case of accommodation as seen by the biologist is identified with the most perfect case of abstract thought that the logician knows.

ALFRED H. LLOYD.

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COMMUNITY OF IDEAS OF MEN AND WOMEN.

Prof. Jastrow's criticism[1] upon the methods, and therefore the results, of a Wellesley College study of the mental community of men and women[2] has led me to repeat the experiment, following with extreme precision the lines which he has laid down. At the outset, I wish to acknowledge the justice of Dr. Jastrow's fundamental criticism upon the divergence of method. The earlier Wellesley experiment should indeed have conformed exactly with the methods of the experiment whose conclusions were questioned. For reasons which I shall later indicate, the divergencies were not considered 'essential,' and the results of the later experiment which I now report seem to me to confirm

[1] PSYCHOLOGICAL REVIEW, January, 1896. p. 68.
[2] *Ibid.* July, 1895, p. 363.

this view in some important features, though not in all. In this new test, lists of 100 words were written 'as rapidly as possible' by about fifty women students of Wellesley. Twenty-five of these lists were chosen entirely at random from among those written in the shortest time. The average time occupied was five minutes and one-sixth second, a somewhat shorter time than that reported by Dr. Jastrow (five minutes eight seconds); the lists are therefore free from any suspicion of being 'less natural and unreflective' than those which he studies. With the efficient aid of Miss Mary A. Dartt the words have been very carefully classified. I have guarded the entrance to every one of the twenty-five classes by a scrupulous consideration of each of the 2,500 words, and have even ventured to submit certain doubtful cases to Dr. Jastrow, to whom my thanks are due for his kind adjudication of their claims.

Before giving the results, I may remark, in reference to one of Dr. Jastrow's comments, that the reason for using only fifteen of the earlier lists, in the count of different words, is a mysterious loss of records. Making every allowance, however, for the increase in repetition with the growing number of words, it is overwhelmingly probable that the ten last lists together contained 300 new words, a number more than sufficient to bring them up to the total of the Wisconsin men's lists. Indeed, the ten cards last classified in the present experiment successively added more than thirty new words to the 'different words' already accumulated, and two of the very latest lists were among the most varied.

The first point at issue is the bearing of the experiment upon the relative tendency to repetition among men and women. Leaving the earlier comparison out of account, the number of different words is given in connection with the Wisconsin results:

Wisc. Univ. Men.	Wisc. Univ. Women.	Wellesley Women (1896.)
1375	1123	1306

The comparison of the percentage of different words (52 %) in the Wellesley lists, with that in the lists of the Wisconsin men (55%), seems to me an insufficient basis for the conclusion that 'there is less variety among women than among men,' especially as it is possible that the slightly greater rapidity with which the Wellesley lists were written may have reduced the number.

The comparison of 'unique words' or words appearing but once, also shows a greater originality on the part of the Wellesley women. Among our 2,500 words, there are 868 which occur but once, while the

Wisconsin men's lists include 746, and those of the Wisconsin women only 520. Dr. Jastrow (who has kindly read this paper in manuscript) regards this large number of unique words as 'suspicious,' adding that "it suggests that a very few students added an unusual number of different and unique words." Our records, however, do not confirm this hypothesis, for they show that the lists which contain an unusually small number of 'unique' words approximately balance the particularly full records. Dr. Jastrow adds that he should have rejected a record containing a long list of prepositions evidently following upon the chance occurrence of the first of them, "as the associations are purely verbal and artificial. What we want," he adds, "is one hundred different ideas." I am sorry that this suggestion came too late to be followed, yet I think that it proposes an unattainable standard, since it seems to me impossible to distinguish, in such lists, between 'verbal' and 'idea' associations.

The view that some other influence than that of sex may account for the difference in 'repetition' between the Wisconsin men and the women, seems to me to be further strengthened by the results of certain experiments in controlled association, first performed by Dr. Jastrow[1] and recently repeated at Wellesley. Ten concrete monosyllabic nouns were successively shown and the subjects were directed, after each, to write 'the first word suggested.' Dr. Jastrow finds that in this case "the tendency to repeat is not stronger in women than in men," and our Wellesley results from 42 records (a number equalling that of the Wisconsin men and greater than that of the Wisconsin women) shows an even lower tendency to repetition; 50% as compared with 65%. Yet if there is really among women a greater tendency to repetition, it should show itself in every form of unreflective and immediate thought.

The Wellesley results distinctly, therefore, oppose the generalization concerning the tendency of women to repeat each other. On the other hand, they seem to confirm several conclusions concerning prominent objects of imagination. The full classification is the following and includes the earlier Wellesley records, for purposes of comparison:

[1] *Educational Review*, II. p. 448.

TABLE OF DIFFERENT WORDS.

	Men of Wis. Univ.	Women of Wis. Univ.	1896. Women of Wellesley.	1894. Women of Wellesley.
1. *Animal Kingdom*,	254	178	146	223
2. *Wearing Apparel and Fabrics*,	129	224	97	96
3. Proper Names,	194	153	81	141
4. Verbs,	197	134	279	114
5. Implements and Utensils,	169	121	139	132
6. *Interior Furnishings*,	89	190	212	84
7. Adjectives,	177	102	300	234
8. *Foods*,	53	179	88	56
9. Vegetable Kingdom,	121	110	101	91
10. *Abstract Terms*,	131	97	101	280
11. Buildings and Building Materials,	105	117	86	106
12. Parts of Body,	101	105	66	34
13. Miscellaneous,	91	97	123	162
14. Geographical and Landscape Features,	97	80	70	142
15. Mineral Kingdom,	74	96	30	54
16. Meteorological and Astronomical,	85	76	109	26
17. Stationery,	60	86	69	26
18. Occupations and Callings,	71	47	24	33
19. Conveyances,	62	52	19	79
20. *Educational*,	34	76	102	167
21. Other Parts of Speech,	96	5	164	41
22. *Arts*,	33	61	17	44
23. *Amusements*,	30	53	17	102
24. Mercantile Terms,	30	29	18	15
25. Kinship,	17	32	42	18
Total,	2,500	2,500	2,500	2,500

The figures of the two Wellesley experiments certainly differ at several points and thus bear out the view of Dr. Jastrow and of Mr. Havelock Ellis, that the lack of extreme rapidity in writing brought about the divergence of the earlier Wellesley results. This difference is very marked in the case of abstract terms which fall far below the figure of the first Wellesley results, though it is proper to add that in the fear of overcrowding the class and in the effort to follow exactly Dr. Jastrow's principle of division, many words which seemed to me genuine abstracts were omitted. The prominence of the class of interior furnishings is the case of most marked agreement with the Wisconsin results. Foods also appear two-fifths more often than in the men's lists, yet only half as often as in the Wisconsin women's lists. On the other hand 'wearing apparel and fabrics,' supposedly objects of ardent feminine interest are named one-fourth less often than in the

men's lists; and 'arts' and 'amusements' fall below any previous level. The results thus confirm some, yet not all, the conclusions concerning differences in predominant objects of interest. They certainly need to be supplemented by other figures since, as Dr. Jastrow remarks, "in dealing with such small groups . . . large room must be allowed for accidental variation."

It still seems to me, however, that such investigation is likely to lead to the confusion of two distinct problems and that one of these is practically insoluble. A statistical study may truly, if sufficiently extended, establish characteristic differences in the interests of men and women, and all Dr. Jastrow's conclusions may in fact be interpreted in this way. Mr. Havelock Ellis, however, and Dr. Jastrow, perhaps, by the expression 'masculine and feminine mental traits,' attempt a distinction between masculine and feminine intellect *per se*, and this seems to me futile and impossible, because of our entire inability to eliminate the effect of environment. Now the differences in the training and tradition of men and women begin with the earliest months of infancy and continue through life. Most of the preferences which have been substantiated by both experimenters, for instance that of women for the surroundings of a home, are obviously cultivated interests. On the other hand, the only characteristics discussed on which the supposed fundamental distinction of masculine and feminine intellect could be based, are the prevalence of abstract terms and the tendency to repetition. On the former score, the figures certainly show more abstract terms on the men's lists, yet the whole number of words considered seems to me too small to warrant fixed conclusions. The number of 'repeated words' is however large enough to form a fair basis for preliminary conclusions, yet just at this point the Wellesley figures definitely oppose those of the Wisconsin experiment. The question of the essential difference between masculine and feminine mind seems to me, therefore, untouched by such an investigation.

MARY WHITON CALKINS.

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Miss Calkins has submitted the above notes to me before publication; it may, therefore, be appropriate for me to record my conviction that the main points at issue, the relative variability of men and women and the differences in their interests, still seem to me to suggest the solution originally outlined in my paper. On re-reading that paper, I can find no suggestion of a claim for a wider application of the generalizations reached than that of the special results presented. The

repetition of the Wellesley results have shown that similarity of method is necessary to comparable conclusions, and they show this so strikingly as to form, in my view, a valuable illustration of the applicability of the statistical method to such problems. On the other hand it is equally clear that the results still differ considerably; this means to me that the data are dissimilar and must be considerably added to by repetition of the experiments in other institutions, before any more definite conclusions can be reached. Inasmuch as the second Wellesley test has brought the results more nearly in accord with the Wisconsin results; and inasmuch as the Wisconsin men and Wisconsin women form fairly comparable groups; and inasmuch as there is other evidence of greater uniformity amongst women than amongst men; and inasmuch as the exceptions to this can in some measure be accounted for, I must still claim that as yet the indications, imperfect as they are, still tend toward the conclusions first suggested.

JOSEPH JASTROW.

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PSYCHOLOGICAL LITERATURE.

Studies of Childhood. JAMES SULLY. D. Appleton & Co., New York. 1896.

The name of this veteran psychologist assures a courteous reception among us, for all his work. Nevertheless, one may fear that this contribution to the psychology of childhood is likely to be undervalued. If the author had proposed a perfect interlocking system of anthropogenesis, or new and daring suggestions toward such a system, if he had covered his pages with comprehensive or with suggestive tables of statistics, or if finally he had written just the book that lies before us twenty years ago—in any of these cases, his work would have been received as an event of first-rate importance. In twenty years, however, a great deal has happened. One thing at any rate has happened and that is differentiation in points of view and in the methods which go along with them. If Mr. Sully belonged more distinctly to some altogether modern group, his book, strong as it undoubtedly is, would be met with the kind of applause and of attack which mean so much more than mere courtesy to a professional colleague. But Mr. Sully's book does none of the things indicated above. It has no closed philosophy of anthropogenesis. It has no startling new theory. It has no statistics. So far as the spirit and method of the book are concerned (much of the *material* is entirely modern) it *might* have been written twenty years ago. And, therefore, instead of applause or attack, the book is likely in many libraries to be placed respectfully upon the shelf with the books of its era.

The reviewer sincerely hopes that this melancholy prediction will prove false. Mr. Sully's book deserves no such fate. On the contrary, it deserves not only from the laity, for whom it was primarily written, but also from professional psychologists, attentive consideration. Mr. Sully has not written the sort of book upon child study which many of us would like to see, but perhaps many of us fail to recognize the independent and permanent value of the kind of book which he has written. The intimate personal, natural history study of children of which the work is composed, was indeed possible as long ago as there were children and thoughtful men to study them, but in all probability, such study of children will never cease to be

necessary. The reviewer believes in the future of a more systematic child study, but the discriminating observations of one who sees with a trained mind, and indeed of a mind trained to be more faithful to fact than to any theory, are invaluable at every date.

Mr. Sully tells what he proposes to do in the following words: "The following studies are not a complete treatise on child psychology, but merely deal with certain aspects of children's minds which happen to have come under my notice and to have had a special interest for me. In preparing them I have tried to combine with the needed measure of exactness a manner of presentation which should attract other readers than students of psychology, more particularly parents and young teachers."

In the introduction, the author discusses critically though moderately, the various methods of child study now current, concluding with the opinion that 'what is wanted is careful studies of individual children as they may be approached in the nursery.'

The author has made a large collection, or perhaps he would prefer to say, selection of observations upon children. A primary rule of selection has been to take observations in which the child with its surrounding circumstances were well known to the observer. Many of the observations were made by the author himself. Others were contributed by his friends and correspondents. Still others were taken from scientific and general literature.

The author has grouped this material about certain main chapters in Psychology (Imagination, Reason, Language, Fear, Morals, Art, &c.). He has written under each head the conclusions or impressions arrived at, supporting these by quotations from the 'observations.'

As an example of the characters of the book I shall give a resumé of the section entitled, 'Germs of Altruism,' (pp. 242–251). The various forms of primitive egoism having been considered in the preceding section, it is now pointed out that children are instinctively attachable and sociable, craving human and animal companionship and miserable when left alone (one case). This primitive form of feeling is not sympathy in the higher sense but a kind of imitation. Thus a dog answers the howl of another dog and a child cries when its parents pretend to cry (case at nine months). Out of such imitation springs the germ of a higher sympathy (two cases in proof of this transition). Later comes a distinct sympathetic apprehension of the other's trouble (case at fourteen months). Early exhibitions of sympathy (case at three years). Consolation (case at two and a half years: case showing more thoughtful sympathy at five years). Helpfulness (case at

twenty-five months). Attempts to give pleasure (case at forty months). Love for animals supplanting fear of them (two cases, one at fifteen months). Sympathy for inanimate objects, dolls, &c. Dread of artistic representations of cruelty (case under four years). Dislike of sad stories. "It appears to me incontestable that in this spontaneous outgoing of fellow feeling toward other creatures, human and animal, the child manifests something of true moral quality."

This brief example which is characteristic of the book will show why it is necessary to cut short this review. There is no way to summarize these refined commentaries shading each into the next from page to page. Just for this reason, however, the book will be valuable to intelligent amateurs who wish help in the observations of their own children.

WM. L. BRYAN.

UNIVERSITY OF INDIANA.

The Psychology of Number and its Applications to Methods of Teaching Arithmetic. By JAMES A. MCLELLAN and JOHN DEWEY. New York, Appleton. 1895. 12mo., 16 and 310 pp. (International education series, Vol. 33.)

No more useful work could be imagined than the application of the results of modern psychology to the improvement of the methods of teaching arithmetic. On the whole, this task is admirably accomplished by the authors of this work. Every intelligent teacher of arithmetic will read the book with profit. The first half is devoted to a careful psychological analysis of the origin of the idea of number as it appears in the fundamental operations of arithmetic. The latter half constitutes a kind of teacher's guide in which the successive stages in the ordinary grammar school course are separately discussed, and specific directions are given about the methods to be followed in teaching. The main fault of the book would seem to be diffuseness and somewhat wearisome repetition; the essential principles and their application might be set forth in a book of less than half the size. But perhaps the authors know their public better than does the reviewer.

The leading thought of the whole work is the demand that, in teaching elementary arithmetic, the idea of measurement should be introduced from the beginning and insisted upon throughout, that continuous quantity, in preference to discrete objects, should be used for illustration, that number should be regarded as a means of valuation, and counting as a particular kind of measuring.

It is doubtless true that, to the mathematician, such a view of num-

ber and arithmetic has something startling, to say the least. Ever since the dawn of scientific mathematical thought, from the times of Pythagoras to the very latest researches of Weierstrass, Kronecker, G. Cantor, and so many others, has a fundamental distinction been recognized between pure number and continuous extension, between counting discrete objects and measuring quantity; and arithmetic, or the science of number, being regarded as the natural starting point of the whole science of mathematics, the efforts to bridge over the apparently insuperable gulf that separates number from continuous quantity have taxed the keenest minds. Indeed, the tendency to 'arithmetize' the whole of mathematics, to base it exclusively on the idea of the whole number as the only sufficiently simple and clear notion of the human mind is a distinct characteristic of, at least, one phase of the most advanced development of modern mathematics. And now we are apparently told in this book that all this is wrong, that the psychologist does not recognize this radical distinction between pure number and continuous quantity, between counting and measuring, that the primary notion is not the absolute integer but continuous quantity, and that, therefore, the idea of pure number should be discarded as far as possible from the first teaching of elementary arithmetic.

How can such directly opposite views be reconciled? First of all, by the fact that elementary arithmetic as taught in the schools is not mathematical science; it is far more a practical art than a science. It is the λογιστική of the Greeks which must have existed long before the foundation was laid for a *science* of mathematics by a clear and definite recognition of the difference between pure number and continuous quantity.

Our authors ascribe the psychological origin of number to the desire, or rather to the necessity in which man finds himself, of evaluating and measuring as accurately as possible, 'to the progressively accurate adjustment of means to end.' Counting thus appears as a means of valuation, number as an expression of value. The reasoning used in proving this position is plausible, if not quite convincing; it is certainly far from accounting fully for the peculiar nature of number. There are numerous cases of counting into which the idea of valuation or measurement does not enter except through a strained interpretation. On the other hand, measuring is often performed, even with considerable accuracy, without any use of number. What is essential in measuring is the actual 'application' of a unit or scale to the quantity to be measured. Similarly, what is essential in counting is the establishment of a one-to-one correspondence between

the things to be counted and the known series of natural numbers. Now while our authors insist very much, and very appropriately, on this analogy between counting and measuring, they do not insist sufficiently, it would seem, on the essential distinction between the two operations, on the distinction between number and continuous extension. It must be conceded, however, that this distinction can only be fully appreciated at a higher stage of mental development, that it belongs properly to ἀριθμητική and not to λογιστική, and that the teacher of elementary arithmetic is mainly interested, as Professor Dewey says in his letter to *Science* (Vol. III., No. 60, p. 288), in the "task of finding out what sort of a mental condition creates a demand for number and how it is that number operates to satisfy that demand."

We cannot refrain from quoting another passage from the same very interesting letter: "The trained mathematician as such is, of necessity, interested in the further use of certain finished psychical products. As a mathematician any reference to the preliminary development of these products can only disturb and divert him. But the problem for the pupil *is how to get the standpoint of the mathematician;* not how to use certain tools, but how to make them; not how to carry further the manipulation of certain data, but how to get meaning into the data." The justness of these remarks will be felt by those who have had experience in teaching mathematics; the beginner's main difficulty lies in 'getting meaning into the data.' And from this point of view the psychological method of our authors is of interest not only for that applied art, elementary arithmetic, but for mathematical teaching generally, even though one may not feel ready to subscribe to Professor Dewey's severe arraignment of 'our textbooks of algebra, geometry and high analysis.'

It is exceedingly desirable that the attempt be made by mathematicians 'to rethink the psychical conditions and steps through which their present magnificent apparatus has grown out of primitive, non-mathematical or crudely mathematical forms up to its present high estate.' But there is some danger that, by insisting too much on this psychological analysis, the pupil, instead of being actually lifted up to the pure mathematical idea, may be left behind with the 'primitive, non-mathematical or crudely mathematical forms' in his mind. To come back to our starting point, it might happen, that, owing to excessive attention to the metrical function of number and to its application to measurement, the pupil might never attain to a clear notion of pure number. Even though the logical number concept and the symbolical aspect of arithmetical operations may be considered as lying beyond

the limits of elementary arithmetic, the teacher of this subject should keep them clearly in his mind. And we should have wished to see more attention paid to this mathematical side of arithmetic in a work primarily addressed to the teacher.

ALEXANDER ZIWET.

UNIVERSITY OF MICHIGAN, May 3, 1896.

Darwin, and after Darwin. II. *Post-Darwinian Questions; Heredity and Utility.* By the late GEORGE JOHN ROMANES, M. A., LL. D., F. R. S. Chicago, The Open Court Publishing Co., 1895. Pp. X + 344.

The Primary Factors of Organic Evolution. By E. D. COPE, Ph. D. Chicago, The Open Court Publishing Co., 1896. Pp. XVI+547.

We are often told that with the advance of knowledge specialization has become extreme. Yet between the zoology and the psychology of fifty years ago, there was but little connection, whereas to-day the more important works in zoology, such as these by Romanes and Professor Cope, could only have been written by serious students of psychology, and in turn every psychologist must read these books. It is perhaps one of the prerogatives of psychology to demonstrate that there are not only sciences, but that there is also science.

Both of the books before us offer special pleading rather than judicial examination. Cope acknowledges and justifies this. He writes: "the factors of evolution which were first clearly formulated by Lamarck are really such * * * and the book is a plea on their behalf." Romanes, on the other hand writes: "I have endeavored to be, before all things impartial." Cope writes with unusual *Derbheit*, with directness and condensation based on intimate knowledge of facts at first hand, whereas Romanes is more diffuse and gives the impression of being an able amateur.

Romanes' *Darwin, and after Darwin* is, it is true, a posthumous work, and did not receive its author's final revision. It has, however, been edited with much care and skill by Prof. C. Lloyd Morgan. The present part is concerned with 'questions of heredity and utility.' In the introduction of 36 pp., the views of Darwin and of the post-Darwinian schools are reviewed. It is so well known that Darwin admitted the hereditary effects of use and disuse, and with increasing emphasis as time passed, that it seems scarcely likely that confusion has been caused, as Romanes claims, by applying the term 'Darwinism' to the factors in evolution made leading by Darwin's works. Wallace

doubtless called his book 'Darwinism' as a tribute to the greater man, not in order to identify Darwin's views with his own. Neither does it seem necessary to argue at length against the claim of Wallace that man has not descended by natural changes from other species. It has been said that as each has a blind spot in his eye, so each has an idiotic spot in his brain, but such spots may be properly left to atrophy. In enumerating the American Neo-Lamarckians Romanes confuses the definite views of Cope, Hyatt and Ryder with the somewhat agnostic attitude of Osborn and of Brooks.

Five chapters of Romanes' book are devoted to 'characters as hereditary and acquired.' The phenomena of reflex action are brought forward as probably the most cogent in favor of the Lamarckian factors, the argument being similar to that from co-adaptation urged by Spencer and others. Romanes argues that reflex actions cannot take place unless all parts of the machinery concerned are already present and already coördinated in the same organism. As the stages of its development cannot have presented any degree of utility, they cannot have been preserved by natural selection. The arguments from co-adaptation (including reflexes) seem to the present writer valid but not conclusive. Romanes states that he perceives that Spencer's arguments based on co-adaptation are equivocal; his own from reflex actions are equally so. If congenital variations can be organized by use into useful reflex actions the variations are already useful, and when further congenital variations occur which tend to relieve consciousness from the burden of interference, they are also useful and will be preserved by natural selection. Here as everywhere the survival of useful variations is accounted for by natural selection, but not their origin. The Lamarckian factors, when they refer to environment, do attempt to account for variations, but when they refer to the guidance of consciousness they invoke a *deus ex machina* and argue *ad ignorantiam*.

Probably the most valuable part of Romanes' book is the account of his repetition of Brown-Sequard's experiments on the hereditary effects of local injuries. The occurrence of epilepsy in guinea pigs born of parents which had been made epileptic by injury to the spinal cord or section of the sciatic nerve was not tested by Romanes, but has been corroborated by others. Romanes states that he has not been able to furnish any approach to a full corroboration of Brown-Sequard's experiments, but he has found gangrene of the ears in the offspring of animals in which this condition had been brought about by injury to the restiform body. Brown-Sequard's results are among

the most curious in the history of science. It is the essence of a valid experiment that it can be verified by any competent experimenter, yet many of Brown-Sequard's experiments remain, in spite of their importance, isolated observations. Brown-Sequard's positive statements in regard to the 'elixir of life,' have, perhaps, made some men of science sceptical in regard to these experiments.

The second section of Romanes' book is on 'Utility' and the four chapters are all entitled 'Characters as Co-adaptive and Specific.' There is an extended discussion claiming that the student of evolution should regard adaptations rather than species, and pointing out the difficulties in the way of defining species. Much of the argument seems superfluous; when Darwin named his work *The Origin of Species*, he did not mean to exclude varieties, genera and families, and the briefest statement of the doctrine of evolution makes it clear that species represent mere degrees of gradation. Romanes holds that many characters are useless and have developed independently of natural selection. He gives as the causes of these, climate, food, sexual selection, isolation and laws of growth. That variations are conditioned upon climate and food is sufficiently evident, but it does not follow in the cases given by Romanes that the persistent adaptations are not useful under the changed conditions. Sexual selection (the taste of the female) and isolation might preserve variations when no longer useful, but do not seem to be efficient causes of their origin. 'Laws of growth' is a phrase apparently used to cover ignorance. There is no one who claims that every character is useful *per se*. The single organism and its relations to the physical and organic environment are endlessly complex, and while it is impossible to prove that every trait is useful, it is equally impossible to prove that any given trait is not or has never been correlated with some useful trait. Further it should be remembered that an organism cannot be permanently adapted to a changing environment, and that 'natural selection' can only build with the materials offered it. The most zealous advocate of natural selection can only claim that it *tends* to establish useful traits and obliterate such as are useless and harmful.

Romanes' book closes with two appendices and two notes. One appendix deals with panmixia and the other with adaptive characters, discussing further the views of Darwin, Wallace and Huxley.

As Romanes' book is itself polemical throughout, the reviewer is apt to follow unconsciously similar methods. But no one can read this book, with its wide and deep interest in fundamental problems, with its sincere and eager search for truth, without a keen appreciа-

tion of the irreparable loss science has suffered in the death of Romanes.

Professor Cope's *Primary Factors of Organic Evolution* is less polemical than Romanes' book and undertakes to offer fewer arguments and more facts. But Cope is even more dogmatic than Romanes and writes as though problems were settled that have as yet scarcely been adequately stated. Still the work is one of great value and importance. The strong impulse that leads men to adopt a definite theory and search far and near for arguments and facts in its support is wholesome for science, for thus stepping stones are laid on which we pass to wider knowledge. If those who make no hypothesis make but few mistakes, they also make but little progress.

The book before us opens with an introduction giving Lamarck's statement of the causes of evolution and tracing the subsequent history of the theory of evolution; and the final chapter of the book reviews the opinions of American Neo-Lamarckians. The three parts of the book are entitled, respectively, 'The Nature of Variation,' 'The Causes of Variation' and 'The Inheritance of Variation.' A large part of the details is outside the province of this REVIEW and the competence of the present reviewer. As far as the paleontological evidence for a given phylogeny is concerned we can but learn from the author, who probably has no rival in intimate acquaintance with extinct species.

In the first part Cope brings forward cases of variation in coloration and structure, quoting at length from others as he does throughout the book.[1] He concludes that variations are not promiscuous but take place in certain definite directions. Just 100 pages are then given to tracing certain phylogenies or genealogies based largely on the author's paleontological research. The third chapter is on the parallelism between phylogenetic and embryonic development, Cope regarding the parallelism as closer and more important than do most recent writers. The fourth chapter entitled 'Catagenesis,' is on regression or degeneracy. 'Sports' are held to be of no importance in evolution. The whole argument of this part is directed to showing that evolution has been due to determinate variation, giving progressive advance along certain main lines.

Under the second part, entitled 'The Causes of Variation,' we

[1] The long quotations from the author's previous publications and from other writers are in many cases superfluous, but in others they are useful, so long as writers will contribute original work to journals such as 'Agricultural Science,' 'The Radical Review' and 'New Occasions.'

find a chapter on 'Natural Selection,' which the author correctly sees to be no cause of variations, whereas the 'Energy of Evolution' and the 'Function of Consciousness,' which he holds to be efficient causes of variation are not placed in this part but under the part on 'The Inheritance of Variation.' The subjects here discussed are environment and the movements of the organism as causes of variations, these factors being called 'physiogenesis' and 'kinetogenesis.'

The chapter on physiogenesis is short and inadequate. Every little boy knows that the organism is affected by the environment and adapts itself to it, even though he may not know what these words mean. The first time he goes swimming in the spring the sun burns his skin, after that it becomes brown and is no longer burned. But what the little boy does not know, and what Cope does not attempt to explain, is how there comes to be an organism that reacts in this way on the environment. Yet this is surely the central problem of Lamarckism. Is the environment the efficient cause or merely the occasion of development and evolution? Later in the book Cope argues that the energy of evolution is not that which characterizes inorganic matter, and thus seems to me to give up the more important aspect of Lamarckism altogether, for I think that the movements of animals and consciousness cannot be regarded as efficient causes of evolution, unless their origin and hereditary transmission can be accounted for without returning in a circle to the nature of the structure and functions of the organism.

Kinetogenesis is discussed at length, 139 pages being given to the subject. The details, largely drawn from Cope's own researches on the vertebrate skeleton, are interesting and show how the structure of an animal is fitted for the movements that it makes. Changes in structure in the individual follow on the movements that it habitually makes, but then why does the creature make these movements? Because they are useful under the circumstances perhaps, but then why does the animal do what is useful? What after all is the efficient cause of an organism that can make these movements and then become still better adapted to making them? If we are referred to 'laws of growth' and 'anagenetic energies,' we have only words no more adequate as a scientific explanation than the *logos* in the first chapter of St. John.

Part III. is on the inheritance of variation. It is amply clear that variations are inherited or there could be no organic evolution. Whether the variations that have resulted in evolution are congenital or acquired by the individual in its life-time, is, as we all know, a vexed question. Cope, however, is very sure that all characters now

congenital have been at some period or another acquired by the individual. The evidence offered in support of this point of view is not extensive, consisting chiefly of Hyatt's observations on the impressed zone of the nautiloids, and cases from breeding collected by Brewer.

The paleontological evidence seems to be ambiguous. If we admit that adaptations in individuals due to mechanical causes have preceded the establishment of these adaptations as hereditary characters, this in itself does not prove that the effects of use are inherited. As Osborn has recently pointed out (*Science*, N. S., Vol. III, p. 530) congenital variations that facilitate a useful action would be preserved by natural selection, and it would appear as though the variations were caused by the action. The cases quoted from Brewer are direct evidence, and if admitted would prove conclusive, but miscellaneous observations that cannot be repeated or confirmed by experiment, have never been important factors in the advancement of science. What we need is an extended series of quantitative experiments on variation and heredity.[1] If these were properly conducted we could learn whether or not a given change in environment or habit would, in a given number of generations, produce any congenital alterations in a species. So long as such experiments are not made it would seem that we are talking too much and working too little.

The chapters on 'The Energy of Evolution' and on 'The Function of Consciousness,' would perhaps be regarded by the author as the most important in the book. In the former he argues that the forms of energy of the inorganic world are also exhibited by organisms, but that to account for assimilation, reproduction and growth, 'anagenetic' energies, 'antichemism' and 'bathism' must be assumed. It may be necessary to go back to vitalism, but if one can do no more than say that life is an exhibition of 'bathism,' the preceding arguments of the book have indeed ended in bathos. It is, I fear, true that Cope is more successful in showing that we cannot account for life by physical and chemical energies than in proving that organic evolution has resulted from 'physiogenesis' and 'kinetogenesis.'

Cope holds that progressive organic evolution is due to the movements of the organism and that the movements are due to conscious-

[1]The nearest approach to these is in observations made incidentally in practical horticulture. Cope does not discuss this evidence, to my mind much the strongest hitherto adduced in favor of the inheritance of characters produced in the individual by the action of the environment.

ness—an effort to attain "some position which is favorable for the procurement of relief from some unpleasant sensation or the acquisition of some agreeable one." Consciousness is thus the *vera causa* of organic evolution. The earth is supported by the elephants and the elephants stand on the tortoises, but then what do the tortoises stand on? Presumably on the earth, for Cope probably holds, though I believe he does not explicitly state, that consciousness is a function of the nervous system. Consciousness and the nervous system take turns in lifting each other to higher places and so we rise in defiance of the laws of gravitation and logic. I do not forget that we are supposed to have the help of antichemism and bathism, so we thus have in addition two words to push us along. When Cope takes the part of metaphysics *versus* common sense, and writes "it is more probable that death is a consequence of life, rather [*sic*] than that the living is a product of the non-living" and "conscious states have preceded organisms in time and evolution," we can but admire the courage of one who writes these things in a paleontological book published in the days of the triumph of material science. Cope promises a special volume on the evolution of mind and its relation to the organic world, and it is but just to wait for this rather than to enter into an extended criticism of a single chapter of the present book.

In conclusion it may be acknowledged that we owe chiefly to Cope and the other American Neo-Lamarckians the clear formulation and partial proof of the proposition that variations are not promiscuous nor multifarious, but are of certain definite kinds and in certain definite directions. This represents an important advance beyond Darwin's position. But we must wait for a second Darwin and a greater Darwin to teach us the efficient causes of variations and of heredity.

J. McKeen. Cattell.

The Whence and the Whither of Man. By John M. Tyler, Professor of Biology, Amherst College. New York, Charles Scribner's Sons, 1896.

The above title is given to a series of ten lectures delivered at the Union Theological Seminary, being the Morse sections of 1895. The fund was left by Professor Samuel Morse, for lectures on the relation of the Bible to the various sciences. To the question of the whence and the whither of man the Bible gives a clear and definite answer. The object of these lectures is to show that science gives an answer in the main in accord with that of the Bible. The first few lectures were devoted to tracing 'the great line of development through a few of its

characteristic stages from the simplest living beings up to man.' The different stages are marked by predominant sets of functions which succeed one another in an orderly sequence. The lowest forms are characterized almost exclusively by nutrition and reproduction. To supply the needs of digestion muscles are developed. Development of the muscular system brings about the nervous system and finally, as connection between stimulus and reaction becomes less and less direct, the growth of the brain. The lower functions, the digestive and muscular systems, have already completed their development; the higher functions, the intellectual and spiritual, are capable of further and apparently infinite development. Professor Tyler looks upon the lower functions as the means for the development of the higher. The end of evolution is the development of mind. If comfort and security, plenty of food and favorable conditions for reproduction, were the goal of development, the clam should be considered the highest product of evolution. The development of mind is parallel to that of body. Already in the hydra we see signs of sentience. In the higher animals we see undoubted signs not only of reasoning, æsthetic emotions and voluntary action, but of moral sentiments, of unselfish love. Evolution is the conformity to environment. The lower animals come into vital relation with but a small part of it. Environment includes all the forces in existence, material and spiritual. Conformity to environment produces therefore in the first place digestion and reproduction, then muscular power, then shrewdness, but finally unselfishness and righteousness. Environment therefore is ultimately God—a personality making for righteousness.

I pass over the chapters showing that this answer of science to the question of the 'whither' of man is substantially that of the Bible—also the very interesting chapter on the present aspects of the theory of evolution, which is a kind of appendix to the rest of the book. The lectures are for the most part fresh and interesting and the argument is clear. But they fail, as most such attempts fail, to give a perfectly definite answer to the main question. We are told that man's future is spiritual; but we already suspect as much. Does 'spiritual' mean the biblical doctrine of a future life for the individual or does it refer to the future existence of the race as such? And, if the latter, of what will that existence consist? These are questions which one inquiring about the 'whither' of man would certainly ask and I cannot see that Professor Tyler has answered them.

WARNER FITE.

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Fear. ANGELO MOSSO. Translated from the fifth edition of the Italian, by E. Lough and F. Kiesow. Longmans, Green & Co. London, New York, and Bombay. 1896. Pp. 278.

This book comes from one of the best known living physiologists. To Prof. Mosso the world owes some of the choicest methods and apparatus ever invented; his peculiar domain being the study of blood circulation, respiration and fatigue, with special reference to mental activity.

In attacking Fear, Prof. Mosso again shows his keen scent for crucial problems. Yet we must confess that the results, this time, revive our impression of how wonderful the inventor was within his old sphere, rather than excite us with valuable contributions for his new subject.

The first eight chapters deal with 'How the Brain Acts,' 'Circulation of the Blood in the Brain during Emotion,' 'Pallor and Blushing,' 'Respiration,' 'Trembling,' and kindred topics. In them the author has collated the principal facts now known regarding these matters, and has done so in language as simple as a child's fairy tale—and often as extravagant. The trouble, however, with this part of the book, from a scientific stand-point is, that late experiments of highest repute[1] explain the mysteries of blood distribution on simple principles which rob the Mosso school of investigation of their chief charm; namely their seeming promise to lead to a solution of the problems of emotion. These eight chapters, therefore, are now behind the times, and misleading if significance be given to them in the last mentioned sense.

Next follow chapters on 'Expression,' 'Phenomena Characteristic of Fear,' 'Fright and Terror,' 'Maladies Produced by Fear,' 'Hereditary Transmission,' and 'Education.' These are disappointing; they contain little that was new even at the date of appearance of the first edition, and by getting no further than did Darwin, Spencer, and Mantegazza, they emphasize how inadequate the conjectures of these great men were in this peculiar field. It is true that to-day very little is definitely known about fear; and this author has perhaps made as good a collection of the fragmentary suggestions currently supposed to have bearing on the subject as is to be found anywhere. But we had a right to expect more from a man of Professor Mosso's originality and rank.

The truth is, the book is full of careless statements and cheap hand-

[1] Shields, John Hopkins. First number of *American Journal of Experimental Medicine*. 1896.

ling of traditional themes. An example of this may be found in the author's so-called 'confirmation' of Mr. Spencer's theory of the origin of emotional expression; which theory is that, in emotional excitement, general waves spread through all the motor nerves, and effect the muscles proportionally to their bulk, and the inertia of the parts they move. In support of this Professor Mosso offers the fact that he stimulated the facial nerve of a dog electrically, and a weak current caused an attentive pricking of the ears; a stronger one gave a movement of the nose and eyes; then the lips and mouth opened; and finally, with a powerful current, the dog assumed the fierce expression of one about to attack—the conclusion being reached that, 'the mechanical part of expression is therefore much simpler than one thinks.' But can any careful man seriously suggest that our various emotional expressions may be arranged in a serial order dependent on the intensity of general nervous discharge! If so, at what point in a child do those for violent laughter pass over into the contortions of crying, or the reverse? And why not explain the movements of Paderewski's fingers by the same 'simple' plan, since they must be the most easily moved members of his body?

As another example of this sort of looseness, Professor Mosso attributes 'frowning' to sympathetic coördination with the eye muscles for purposes of scrutiny and attention. But why then, at the theatre, do persons in rapt attention and scrutiny of the comedian's antics raise the brows in the most open and expansive manner? And do we not scrutinize the marvellous as closely as the disgusting, yet with the brows set quite oppositely? We are not likely to arrive at any profound insight into emotion, until scientists are willing to guess at its problems a bit more searchingly than they would at a newspaper riddle.

Again, in the chapter on Heredity the doctrine of Acquired Characteristics is asserted as unquestioningly as if the great Weismann controversy never existed. Yet regarding its scientific aspect it remains to be said that the fundamental error of this book is the author's entire neglect of the psychologic side of his subject. Never once does he even try to approach it; and one should know, from the first, that a treatise on fear, with the psychology of fear left out, must be as unsatisfactory as an attempt at mint julip, which gets no further than the glassware.

In summary: The translators tells us that this is a 'splendid little work.' Rather it is a splendid little Vaudeville; a potpourri of all sorts of things, from Professor Mosso's Physiological Scrap Book, thrown together for the popular stage. The book is valuable, as any work from

this distinguished scientist must be; but we feel that he stepped down to write it. It is good to bring science to the people, but in doing so one should never descend to tawdry, and much of the rhetoric of the present book comes near this. Scarcely does a cock-sparrow perform more preposterous antics at courting-time than does this author, in places, to drive his subject home upon the attention of 'popular readers.' (Pp. 36, 74, 200, for example.)

The work of the translators, Mr. and Mrs. Kiesow (formerly Miss Lough), is extremely commendable, and the type excellent.

HERBERT NICHOLS.

JOHNS HOPKINS UNIVERSITY.

Evolution in Art: as illustrated by the Life-history of Designs, By ALFRED C. HADDON, Professor of Zoölogy, Royal College of Science, Dublin. London. Walter Scott, 1895. Imported by Charles Scribner's Sons. Pp. XVIII, 364. $1.25.

There is a great deal in the title given to a book; and psychologists, interested as they are in all that relates to evolutionary doctrine, will I fear suffer some disappointment when they find that Professor Haddon's excellent treatise deals with little more than the indications that some art forms are developed by slow processes determined by the inheritance and the character of men as affected by their environment. But this disappointment is likely to be displaced by a sense of satisfaction, that they have been induced to read a work that might have been passed over had the title been more accurately descriptive of the contents.

Professor Haddon undertakes to study certain designs used in art, treating them as products of biological evolution; and he succeeds in showing, rather by accumulation of indirect evidence than by formal argument, that the processes discoverable in the psychic life of man are adequate to account for the original use of the principal decorative designs, found amongst the savage tribes to which he turns his attention; and that the persistence of certain of these forms, modified to a greater or less degree, is on the whole exactly what we should expect to find in consideration of our knowledge of the psychic life of man as, influenced by imitation, he passes through the normal processes of mental evolution.

Of the higher forms of decorative art the author, perhaps not unnaturally, has little to say; for to him, as to all biological evolutionists, the genesis of man's capacities seems most clearly exemplified in the lives of uncultured barbarians.

Where Professor Haddon touches upon matters of distinctly psychological significance (*e. g.* p. 308) he shows himself to be a somewhat crude materialist; but as he is not often led away from purely biological discussion, this crudity does not take from the worth of the book which will surely be of value to all who interest themselves in artistic development.

In these days when we are beginning to realize that art must be treated scientifically, that it is no mystic gift from the gods which we must worship but which we may not defile by ordinary investigations, all books are welcome which, like the one before us, tend to lead the man who devotes his life to artistic production to take a common sense view of the nature of his endowments.

The book is fully and satisfactorily illustrated. The classification, thrown in somewhat at haphazard on p. 8, appears to the writer of this review to require full explanation; as it stands it does not seem logical, and it is clearly not necessary to the argument of the book.

H. R. MARSHALL.

Inductive Logic. By JOHN GRIER HIBBEN, PH.D. New York, Charles Scribners' Sons. 1896. 8vo. Pp 345.

The preface of this work states a very good reason for its existence, and this reason is the impression often obtained that deductive logic constitutes the whole body of logical doctrine, while as a matter of fact the largest amount of our actual reasoning is inductive and should receive corresponding emphasis and consideration in methodology. This is quite true, but the value of deduction method is liable to depreciation by contrast, unless we give equal respect and attention to the natural demand for a certitude which induction does not give, and which governs many attempts to apply deduction for that purpose. Besides this, the training in deductive methods with all its laboriousness and elaboration, is the best corrective of dogmatism in the inductive field, by exposing the difference between methods which give assurance, and those which keep within the limits of probabilities until verification has done its work. It is assurance in conviction that most inquirers seek, and if they are taught by indirection that it can be obtained by inductive reasoning alone, there will be little to discriminate between conjecture and certitude, and much to encourage an unhealthy dogmatism. Not that I am charging this tendency to the present work, but only that there is equal danger in discussing induction without deduction.

The method of treatment is somewhat open to criticism. The first

chapter properly treats of the nature of the process, but unfortunately implies by both its title and the discussion that 'induction' stands always for an inference or process of ratiocination, though the fact is that it often is synonymous with scientific method, which may be more than reasoning, and in one of its historical meanings is only a process of generalization by observation, the *inductio per enumerationem simplicem*. In the fourth chapter this simple enumeration is directly classified as one form of the inductive inference in the face of the fact that logicians generally repudiate it as a process of inference. Even Bacon excluded it from the 'induction' which he was discussing, and which he intended to treat as going far beyond mere observation. The second type of inference seems equally faulty in that it identifies analogy and comparison. A man may define analogy to suit this purpose, but many logicians consider analogy as treating only of a resemblance in relations and not a resemblance of essential qualities. This view ought at least to be mentioned and discriminated from the conception here maintained. In the chapter on Analogy there is no trace of the method employed by Bishop Butler and similar writers and discussed by Ueberweg and Jevons. Much confusion must follow such a loose identification between analogy and comparison.

Less objection can be presented to the several chapters following the fourth and including the topics Causation, Causal Analysis, Inductive Methods and Verification and Prediction. But it is quite singular that the subject of Hypothesis should be postponed to the thirteenth chapter ; for if anything is of the nature of an inductive inference hypothesis is such. But it is here treated as if it were something else altogether and yet is not defined as more than a preliminary to experiment. This would make scientific method begin with hypothesis to be followed and ended by verification, and exclude the necessity of inductive reasoning altogether, unless we at last decided to identify hypothesis and inductive inference, which is not consciously done in this instance. According to the author's definition of inductive reasoning, as taking us beyond the premises, he ought to make hypothesis the very essence of inductive inference, as the very step which takes us beyond the premises, and such a course ought to place the discussion of it before that of verification, and at least in the chapter pretending to define induction. But the author evidently intends to treat it as wholly distinct from the ratiocinative process known as inductive, and yet he would not regard it as deductive, nor as a form of observation. He must then regard it as a third kind of reasoning new to logicians, or has not discovered its identity with induction as defined

by himself. The oversight probably comes from the tendencies to use the term 'induction' as a name for scientific method and forgetting its distinct meaning as a ratiocinative process.

Only one other criticism requires to be made here and it is that in the present critic's opinion many of the illustrations in the body of the work might better be used for practical examples and exercises, at the end where there is a very good collection of them. Illustrations are very important, but only a few require to be carefully analyzed in order to explain the matter of method. For this reason more attention might have been given to an abstract-explanation of the method, and then left the teacher to require its application in the same way to a large number of promiscuous examples.

Taking the book as a whole and considering its merits, it is certainly very clearly written and free from technicalities of style or undue philosophic speculation. It will serve very well the purpose for which it was written, and is hardly inferior on the whole to Fowler's work on the same subject.

JAMES H. HYSLOP.

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VISION AND GALVANOTROPISM.

Spectrobolometrische Untersuchungen über die Durchlässigkeit der Augenmedien für rote und ultrarote Strahlen. E. ASCHKINASS. Ztsch. f. Psych. u Phys. d. Sinnesorgane. XI., 44–53.

The fact that the eye communicates to the brain a sensation of light over only a small portion of the spectrum, may be due to either of two facts—the nervous apparatus, or, if a chemical process intervenes, the chemical apparatus may react only to waves of a limited range of lengths, or the invisible rays may be so absorbed by the media of the eye as not to penetrate to the retina. It has been conclusively shown that for the ultra-violet rays the latter is not the case, and that the ground of their invisibility is in the insensitiveness of the retina. With regard to the ultra red rays the evidence has been conflicting. Aschkinass has therefore applied the spectro-bolometric method, which has now been brought to great perfection, to the determination of the question, with the result of showing that the media of the eye have an absorption-spectrum very nearly the same as that of water, and that our blindness to ultra red is due to the same cause as our blindness to ultra violet, namely, the insensitiveness of the retina.

Color Saturation and its Quantitative Relations. By A. KIRSCHMANN. Am. Jour. of Psych., VII, 386–404. 1896.

The principle contribution of this paper is the description of a color disc constructed so as to exhibit from center to periphery a constantly changing saturation with an invariable color-tone and intensity. This is accomplished in the following manner: A number of concentric rings are drawn on a circle, and from the center are drawn, at equal distances apart, twice as many radii as there are concentric rings, if there are fifteen rings, two adjacent radii would be twelve degrees apart. If the points where the radii meet the corresponding circles (the *n*th radius the *n*th circle on each half of the diagram) are connected by a curved line, a symmetrical heart-shaped figure or leaf will result, such that the fractions of the successive rings inside the leaf decrease in an arithmetical ratio from the center to the periphery. If now a leaf of this shape is cut out of colored paper and pasted on to a gray disk, a color will be obtained, upon rotation, of constantly diminishing saturation from the center to the periphery. But in order that the intensity may at the same time be invariable, it is necessary that the gray chosen should be of exactly the same brightness as the colored paper of which the leaf is made. To avoid the vain search for such a gray for all papers, it can be made for each ring by another application of the method already used. The brightness of the colored paper is first determined by the method of Rood, or of the author, to be equal to that of a gray composed on the rotating disc of a given proportion of white to black, and the portions of the rings outside the leaf must then be made up of black and white in this same proportion. When the number of rings is very large, the boundary of the leaf becomes an Archimedic spiral, for which the author gives the equation, and also for the boundary of the black and white surfaces. The discs so constructed actually exhibited a constantly changing saturation with an invariable color, tone and brightness. They have been used for testing the validity of Weber's law for degrees of saturation; the results of this investigation are not yet published.

If these discs are made in black and white, since the change of brightness proceeds in an arithmetical ratio, the disc does not seem to grow brighter or darker towards the edge by regular degrees; that would be effected by a separation of the black and white by a curve giving equal multiplicative increments instead of equal additive increments. Such a curve would be, in polar coördinates, a transcendental curve analogous to the logarithmic curve in rectangular coördinates. The equation of this curve is given. The corresponding discs have

been made, the construction being for each third of a circle, to obviate the necessity for very rapid rotation, and the increase of intensity being either from center to periphery or from periphery to center. In both cases the discs, when in rotation, present to the eye a surface with apparently uniform transition from black to white, that is, they make the impression of an arithmetical increase of intensity, and hence form a beautiful means of demonstration of the psycho-physical law.

There is also a modification of the double cone representing the entire gamut, or rather volume, of light sensation, by which expression is given to the fact that yellow is the brightest color of the spectrum, and violet blue the faintest, and that the whole spectrum grows more yellowish as it grows intense, and more bluish as it grows faint.

Zur Theorie des Galvanotropismus. JACQUES LOEB und S. S. MAXWELL. Pflüger's Archiv. LXIII., 121–144.

Every advance made in the investigation of those phenomena of nature which are of a positive and negative character, whether it be the effect of the two opposite directions of the electric current, the results of katabolic and anabolic changes in nutrition, or the action of opposite groups of muscles, is of wider than immediate interest; one never knows when general principles may be made out which will enable us to disburden the world of anachronistic theories of light-sensation which ought long since to have received their final quietus. There is therefore a special interest attaching to this paper on galvanotropism, by writers one of whom has for some time made the subject peculiarly his own.

The phenomenon of animal galvanotropism was discovered by Hermann. He found that the larvæ of frogs and other animals have the remarkable property, when in a long trough through which an electric current is passed, of placing themselves with the head towards the anode (the antidrome position), and that those which remained in the opposite (homodrome) position exhibited a constant restlessness. His explanation of the phenomenon was that the current acted upon the central nervous system, and that the latter was permanently excited by the ascending current, and more or less paralyzed by the descending current, and that the larvæ sought instinctively the position of least excitation. The experiments here described, which were performed on crabs, have convinced the authors that the assumption of a quieting effect by the descending current, and of an exciting and painful effect by the ascending current, is incorrect. They find that the immedi-

ate effect of the constant current consists, in crabs, in a change of tension of like sense in associated muscle groups, and of such a nature that on the anode side of the animal the tension of the flexors is greater, on the cathode side that of the extensors. This difference of tension of antagonistic muscles causes these animals, on account of the peculiar mechanism of the organs of locomotion, to swim towards the anode; if the current is strong, they become completely stiff when in the antidrome position; in the homodrome position they are not completely stiff, and can still swim backwards toward the anode. The same assumption of changes of tension of associated groups of muscles the authors believe to be sufficient to account for all the corresponding phenomena exhibited by vertebrates.

Interesting photographs are reproduced of the crabs with their legs stretched out and bent in accordance with this rule. The real state of things was not discovered before, because animals without legs were largely experimented upon. Galvanotropism will, without doubt, prove an efficient means for the determination of the position of motor centers.

The effect of the electric current upon the retina is to cause complimentary color sensations according as it is ascending or descending. It is odd that Hering has not dwelt upon this circumstance more than he has done as support for his conception, that complementary colors are connected respectively with assimilation and dissimilation. But it is perhaps fortunate for his theory, for it now appears that the polar quality of the current translates itself in the animal organism, in this well-marked instance, into a *quality-change* of some sort in the muscle-regulating nerves and not in a simple variation in assimilatory or dissimilatory activity. For it will hardly be assumed that an increased tension of a flexor muscle is brought about by increased nutrition and an increased tension of an extensor muscle by increased degeneration in the muscle, or in the nerve which regulates it.

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The Colour-Sense in Literature. HAVELOCK ELLIS. Contemporary Review, May, 1896.

Mr. Havelock Ellis gives the results of his investigations as to the color words most used by representative writers from Homer down to the present day, including Olive Schreiner and D'Annunzio. His only Latin poet is Catullus, thus omitting Vergil and Ovid both of whom had a very keen sense of color. From a partial survey of

twenty-five authors, Hebrew, Greek, Latin, French, Italian, English, etc., he sees that the color analysis of a writer's style will furnish a very delicate means of telling "at a glance something about his views of the world which pages of description could only tell us with uncertainty." What this something is the writer of this article does not tell us. But he concludes that the use of color in the writers of to-day, as it much more nearly resembles that of the time of Chaucer and of Shakespeare, than does the usage of subsequent writers, shows that in our color sense at least we are not degenerate.

We are told that in literature red symbolizes man; blue and green, nature; white, yellow and black, imagination; and the results of Mr. Ellis' investigation as shown in his tables seem to corroborate this generalization, as red is the most predominant color, black, white and yellow come next, and blue and green occur least often. But when he says that a poet, in using black, white and yellow, 'the color of golden impossibilities' is marked thereby as a poet of the imagination, his statement is an example of what may, if not supported by extensive statistics, turn out to be false analogy. WILFRID LAY.

PATHOLOGICAL.

L' Etat Mental des Mourants. P. SOLLIER, A. MOULIN, ALEX. KELLER. Revue Philosophique, XLI., 303–313. March, 1896.

Continuing the discussion begun by M. Egger (see above p. 236), MM. Moulin and Keller record in detail youthful experiences of their own in drowning, the latter also a more recent experience of syncope, while Dr. Sollier reports observations, notably of several grave cases of morphinomania, in which the sudden suppression of the habit seemed to the patient to threaten fatal consequences. The most constant phenomenon in all these cases is the feeling of blissful repose preceding the loss of consciousness. In only two of the ten instances here cited is there any vivid revival of the past life. M. Keller says that among twenty cases known to him, not one presented this phenomenon with any precision. The most distinct idea in the minds of both the drowning youths was that they would never again see their relatives. Both also experienced hallucinations. As to the feeling of fear, Moulin felt none till after the rescue and then it seems to have been due to chill; Keller, however, speaks of the self as full of fear till the recognition of the impotency of the struggle brought repose—an evident, and pos

sibly false, interpretation. Sollier is careful to distinguish the cases; the question raised by M. Egger, he says, relates to the reaction of the self, not to death, but to the idea of death, and this varies within a wide range of possible combinations of circumstances. Confining himself to death from sudden accident, on the one hand, and to death from rapid exhaustion of the organism on the other, he proposes the following theory to account for the feeling of beatitude, the analgesia and anæsthesia noted by M. Egger, and the vivid resurgence of memory-images. The more negative than positive feeling of blissful repose he regards as the direct result of the bodily insensibility. The latter, in the case of accident, is due to distraction of the attention, its concentration on the object. The feeling of self is here, in the struggle for self-preservation, at its maximum, and hence, possibly, the spontaneous, panoramic vision of the total past self. In the pathological cases, the bodily insensibility is due to physical exhaustion. Here, too, the self is thrown back upon its past organization. Thus in the first case, the revival of memory-images is connected with exaltation of the former, in the second, with the suppression of the actual self. This is probably a little schematic and Dr. Sollier has himself the good sense to say that it is only a theory and to suggest further inquiry along the lines indicated.

H. N. GARDINER.

SMITH COLLEGE.

Ueber die Delirien der Alkoholiken und über künstlich bei ihnen hervorgerufene Visionen. H. LIEPMANN. Aus den psychiatrischen und Nervenklinik der Königl. Charité (Prof. Jolly), Berlin. Archiv für Psychiatrie, Heft I. 171–232. 1895.

In the above treatise the author communicates observations made in the summer of 1894 on 125 alcoholists at the Charité in Berlin. His first method of procedure was to make himself acquainted with the previous history of the patient's illness. On account of unavoidable incompleteness in this method, however, the author next endeavored to produce artificial visions in the delirious. The above work is therefore divided into two parts: I. Spontaneous delirium, II. Sense deceptions artificially produced: pressure visions.

I. The author considers the affective side of spontaneous delirium and the fancies of the delirious, dwelling more particularly on the anomalies of their sense-activity, their illusions and hallucinations. Taken as a whole the conclusion arrived at is, that the primary effect dominating the inner life in delirium tremens is fear, which then

leads to actions for self-preservation. Elementary sense-anomalies appeared in many cases even before the outbreak of the actual disease.

II. In common with Näcke the author propounds: "If all or some of the hallucinations of the delirious drunkards arise from stimuli, then conversely, artificial production of such must call forth hallucinations." The simplest and least harmful irritant appears to be a continued pressure on the eyeball. The author suggests that Purkinje's figures produced in healthy subjects by pressure on the eye, which belongs to the domain of normal sensations, is transformed in the delirious into complicated visions, in which they see and even fluently read printed and written characters. The author then seeks to prove that visions so produced are caused by the pressure as such and are not a continuation of spontaneous visions. He further shows that this method is not only applicable in the case of delirious alcoholists, but could also be extended to the investigation of hallucinations in general, although he only wishes his own plan to be considered as a beginning in the investigation of sense deceptions.

It may be added that the author holds delirium tremens to be an acute exacerbation of chronic alcoholism and that in the 'Abortivformen' described by Näcke, he only recognizes a lower degree of the same disease.

FRIEDRICH KIESOW.

LEIPZIG.

EXPERIMENTAL.

Experimentelle Studien über Associationen. By GUSTAV ASCHAFFENBURG. Psychol. Arbeiten, 1895, I, 209–299.

The present investigation deals with normal cases entirely, and is preliminary to a study of the effects of fatigue and stimulants upon association. For the kind of stimulus used in these experiments —a word spoken by the operator—the author adopts the following classification: I. Immediate Association: a. Internal, (embracing) · 1. Co-ordination and subordination: 2. Relation of predication: 3. Causal relation. b. External: 1. Space and time; 2. Identities (synonyms, etc.); 3. Revival of former verbal succession. c. Stimulus acting merely as sound: 1. Completion of word; 2. Association through sound or rhyme. d. Stimulus producing merely reaction · 1. Repetition of stimulus-word; 2. Repetition of former reaction without meaning; 3. Association with former stimulus; 4. Reaction with no traceable connection. II. Mediate Association.

Three distinct methods of research were employed. In the first

only the initial stimulus was given by the operator; the subject was required to write down in order his successive associations until a list of 100 had been made; these were then examined and classed according to the above scheme. In the second series the subject responded to the given word by a single association, and a number of such associations (usually 100) were included in the series. Finally, experiments similar to these latter were made, in which, however, the reaction-time was also measured, by means of a pair of lip keys. Seventeen different persons in all acted as reagents, and the entire investigation consisted of 44 series of about 100 experiments each. The comparatively small number of series recorded may be attributed to the amount of time necessarily spent in preliminary practice. Certain series are open to admitted objections, on account of the variability in physical and mental conditions which it was impossible always to avoid.

The external associations were in general more numerous than the internal, and show on the average a shorter duration. The reaction-time varied greatly among the reagents, the average lying between 1100σ and 1400σ; one reagent gave a much lower average, and one a considerably higher (2000σ); hence a long association time cannot be considered *prima facie* evidence of pathological conditions. Lack of complete attention is indicated by a tendency to associations of the types *c* and *d*, as well as by a break in the series under the first method; while repetition of the same associations in the same series may indicate the presence of unfavorable physiological conditions. An interesting fact brought out is the frequency with which the same stimulus led to the same word-association in different individuals. The same stimulus-series was given to five different persons; all five had 2 responses in common, four had 4, three 16, and two 39, out of 100. Another series given to four different persons shows similar results. These percentages may be regarded as the measure of their common 'intellectual atmosphere.'

Apart from such general conclusions as these the results are rather negative. They serve to emphasize especially the fact of *individual differences under substantially the same conditions*—the fact that important differences exist among normal individuals in respect to both the kind of association and the length of reaction-time.

PRINCETON. H. C. WARREN.

Die Aufmerksamkeit und die Funktion der Sinnesorgane. By W. HEINRICH. Zeitschrift für Psychologie und Physiologie der Sinnesorgane. Vol. IX., Nos. 5 and 6, pp. 343–388.

The present theories of attention, says Dr. Heinrich, are unscientific since they are arrived at by explaining the known by the unknown (Wundt, Külpe); or else by reducing attention to association (Ziehen) or to muscle sensations (Münsterberg) which do not explain all the phenomena of attention. Experimentation must be introduced to control conditions, and do away with introspection. It is generally belived that attention is independent of the sense organs. This is thought to be supported by the experiment of Helmholtz in which he found he could change the direction of visual attention without the aid of visual objects. Helmholtz, therefore, concluded that the attention is wholly independent of the accommodation of the eye.

Dr. Heinrich considers this verdict unscientific, and devised a method to test it by physical measurements. A perimeter was used with an ophthalmometer having cross threads on its front end for a fixation point. The latter was placed close behind the perimeter so that the axes of the two instruments coincided. With the left eye fixated on the threads and the right eye covered, the subject was required to direct his attention to white squares, 2½ cm. to 4 cm. on a side, placed at an angle of 50°, 60° or 70° to the left along a meridian, and to tell what letter was printed on the square. In one form of the experiment the light came from a gas lamp placed near the perimeter on the nasal side of the left eye. In another form the light came from one northeast window, the other windows being darkened. In both cases the image of the light was reflected in the middle of the pupil. The head was steadied by a prop held in the teeth.

Following are the diameters of the pupil in millimeters taken from the ophthalmometer when the white squares were at different positions, and also when the subject performed a difficult problem in multiplication.

	With gas lamp.	With daylight.
Square fixed centrally	3.1437	3.0091
" " laterally 50°	3.6899	4.9094
" " " 60°	4.1245	
" " " 70°	3.3247	3.9514
With reckoning	4.3943	6.0565

Dr. Heinrich concludes that:

1st. The pupil enlarges when the attention is turned to an object seen laterally. This is dependent upon the angle of the laterally seen object.

2nd. When the subject turns his attention wholly from the object

as in reckoning, the pupil is enlarged most of all. Since the light was constant these changes were not due to changes in light, but to changes in attention. Later modifications of the experiment in which black squares were used, and when the light came from behind, show that the adaptation is inconstant when the attention is not on a visual impression in the axis of vision. The curvature of the lens was found to undergo similar changes.

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EPISTEMOLOGY.

Zur Kritik des Seelenbegriffs. A Vannerus. Archiv f. System. Philos. Bd. I. Heft. 3, 1895.

The author investigates Prof. Wundt's conception of the soul, as neither an *ensemble* of associatively bound together elements, nor a material or spiritual substance which underlies the empirical flow of changing states, but as on the contrary a real activity which is actual in that it is immediately known in psychic experience—an activity which is a known *Ding an sich.* The author admits that from a psychological standpoint the Wundtian conception is the true one; but contends that from an objective point of view the conception exaggerates the fact of activity. Activity presupposes an actor. Yes, replies Wundt, in the objective world of material things; but "the unity of volition (Willenseinheiten) to which the ontological regression leads is not an acting substance but rather a substance-producing activity." To the author, who substitutes a unified whole and its contained elements for the changing appearance and underlying reality which Wundt names the 'substance-concept,' 'an absolute change is a logical and psychological impossibility.' Activity, event and change are all causal conceptions; and thought must embrace their ground just as much as the effect. The comparing, relating functions (*e. g.*,) demand a permanent subject. We may conceive this common factor in all mental states as an activity, indeed as a *pure* activity if we hold fast the thought that it includes a constant factor which consists in this that it is always one and the same activity, viz.: the relational function. If the author means an activity which *in form* is always one and the same, his conception as here expressed is probably identical with that of Prof. Wundt; but if he means one and the same *actor*, the discussion becomes a defence of the 'substance-concept' of which, as the author writes, Prof. Wundt is 'the sworn enemy.' But the relation of the author's own position to that of Wundt is not perfectly

clear in some parts of the discussion. The author's many references to Wundt's works make the discussion very helpful, as well as suggestive, to those who wish to study the Wundtian conception in the original.

The author seems finally to make a separation of the changing content of consciousness from its underlying ground, conceived as permanent; but this is of course just the effort to reduce the soul to mechanical conceptions which Prof. Wundt regards as both unnecessary and seductive. It may still be true that the soul cannot be logically, *i. e.*, mediately conceived, and must be immediately realized in the unity of its own activities; and this possibility the author does not seem to discuss.

Grundlinien einer Theorie der Willensbildung. PAUL NATORP: Archiv f. system. Philos. Bd. I. Hefte 2 and 3. 1895.

The author's problem is pedagogical, 'the content of that which should be developed out of man,' the theory of knowledge and æsthetics being as important as ethics in determining the answer. 'Will is direction of consciousness' determined by the unconditional demand for 'unity in the manifold,' to which consciousness stands related not only as a legislator to his law but also as subject. The author's Unconditioned is this object of demand not merely as something existing but as something which ought to exist. Will is thus something fundamentally different from the determination of action by the position in which one finds himself or by an estimate of positions in which he is able to place himself. From a formal point of view it is the necessary reference, imposed by consciousness upon itself, to the unconditioned as law. Its material content is determined by experience, the bond between them being expressed as direction, striving or tendency (Trieb).

What, *in concrete*, is the object of will? Three considerations determine the author's answer. Tendency in some direction is presupposed—this is Bain's spontaneity and Baldwin's 'Law of Excess.' Will, formally considered, gives to tendency its form— the unity of direction which consciousness unconditionally demands, at the same time rendering tendency objective in its reference. Tendency is *a priori* and must be centrally grounded and not peripherally. The objective reference of Will is ignored by all who (as Hume) see in it merely a sum of given simultaneously operating forces. The firm belief in a thing, that it means unity, explains both fanaticism and heroism. Rational will, the third consideration, adds to unity of tend-

ency the insight that this is the Unconditioned. Whence then, rational will? The author's answer is social Technique, the influence of society with her opinions, institutions and customs on the individual—'moral consciousness is social consciousness.' The individual depends on society for self-consciousness, for perception or his view of his not-me, for his opinions and ideals. The pupil must not see with the teacher's eyes, but imitate the teacher in the use of his own. The primary influence of society is on the will; one learns to will by putting himself in the point of view of others. The law for the individual is; to give to the will the direction which society is disposed to demand, *i. e.*, the law of humanity. The good is a problem for the individual only in so far as he participates in the life of the whole. What morality is for each depends upon what it is for persons in general.

The author develops a system of cardinal virtues embracing Truth, Moral Strength, Purity, the moral ordering of the emotional life; and Justice, 'the love of the wise man.' This part of the discussion is very interesting and throughout suggestive.

On a Kantian basis the author goes to the bottom of the question of will. In the account of the social nature of the objective consciousness, the author's view resembles that of Prof. Royce. The principle of imitation as the law of individual appropriation of that which society offers its members, the principle which Prof. Baldwin in his last work has shown to be of tremendous importance in this connection, is also hinted at by the author. Rather than the theory of self-dependence and self-legislation of the transcendental idealists, the discussion leans toward the opposite extreme of making the individual entirely dependent on society, just as Prof. Royce seems to in comparing the relation of the individual to society to that of a hypnotic subject to an operator. That instinctive sense of unity which consciousness contributes to Will, especially in individuals possessed of a high degree of what the author names Tendency, *i. e.*, Geniuses, often asserts itself against society in favor of an ideal so superior to society, it may be, that the latter cannot appreciate it. Moreover, the author emphasizes the legal, formal side of the Unconditioned as aim. This has two difficulties—moral development becomes the problem of following a rule, life is 'sicklied o'er with the pale cast of thought;' and then there are no ideal formal laws capable of obvious application to conduct. This conception really makes unnecessary the principle of imitation at which the author hints. Finally it remains unclear to us what the author's Unconditioned, as a matter of concrete content, is, although he has given it a clear formal determination.

Neither Spinoza's absence of determination, nor Kant's sum of all conditions, nor Spencer's sum of all force would answer. All that the author says points to self-consciousness in the form of self-activity as that which alone transcends the empirical manifold and becomes the aim of Will. But if we ask for a closer definition of self-activity, we simply come back to the question to answer which the interesting discussion was written. The individual depends on society, but society is a sum of individuals, and streams do not rise higher than their source. According to this it seems as though our moral emotion ought to be what it is, not merely an aspiration after something better than we are; whereas it has in fact a positive demand that we be that which we ought. It seems as though this difficulty is not solved by the discussion. GUY TAWNEY.

LEIPZIG.

Ueber Glaube und Gewissheit. JULIUS BERGMANN. Ztsch. f. Philos., 1896, CVII., 176–202.

Following the tendency established by earlier theological writers, many philosophers down to the present time have inclined to regard the belief based upon our ordinary avenues of knowledge as implying some degree of uncertainty. This is the reason for the many attempts that have been made to discover other avenues of knowledge capable of yielding more certain results. Herr Bergmann, on the other hand, claims that certainty is the essence of belief of every sort.

"The belief in the content of a judgment . . . is never something added to the judgment, but the judgment itself *is* this belief." Every judgment carries with it a belief not only in its own truth, but also in its own certainty. In order to this certainty, one must have an *assurance* of truth. Such assurance is found, either (1) in the *identical* character of the proposition; or (2) in its agreement with *experience;* or (3) in the fact that the judgment follows as a *consequence*, from recognized truths. The only real assurance of the truth of an opinion, then, is the perception of its truth; *i. e.*, the perception (which may be but dimly present in consciousness) that one of these criteria holds with respect to it. Belief and the feeling of certainty thus become functions of the *understanding;* and the understanding is the sole judge as to whether a thing which has been considered true and certain is so in reality. Truth is not an attribute of the notion as such, but merely of the notion as predicated, and hence belief is always belief in objective certainty, or truth.

The present paper is a defense of the writer's views as elaborated in his work: 'Die Grundprobleme der Logik,' and to this he refers in

several places for amplification—*e. g.*, in his discussion of Kant's synthetic judgments *a priori;* Herr Bergmann holds these to be merely special forms of the analytic judgment, as of course his scheme would require of all necessary judgments. H. C. WARREN.

PRINCETON.

L'Hégémonie de la Science et de la Philosophie. A. FOUILLÉE. Revue Philosophique. Philadelphia. January, 1896.

The Hegemony of Science and Philosophy. INTERNATIONAL JOURNAL ETHICS. January, 1896.

The problem which the author would consider under this title is stated at the outset in the form of a question. Are there, as the Kantians hold, limits beyond which scientific methods do not apply, regions in which speculation must be controlled by entirely different principles? Or is there, as Aug. Comte would hold, a 'cerebral unity' of mankind capable of being constructed on the data of science alone? To which of the two must we grant the true intellectual hegemony (p. 137).

The author distinguishes between two senses in which the term science is used. In its broader sense it means 'a rationally established system of facts and ideas which, over a given range of objects, confers certainty, assurance, probability, or even a doubt that knows why it doubts' (p. 143). Thus understood science includes any belief founded on reason; universal philosophy as well as so-called special sciences. It excludes belief 'founded on the authority of others, not regulated, and incapable of demonstration, or on the imagination or feelings to which a supernatural bearing is given.' In its narrower, its 'true' sense, however, science 'hinges on the relations of objects to each other, independently of their relation to the sentient and thinking subject.' It is 'the perception of the constant relation between things such as these appear to us, independently of what they may be in themselves' (p. 144). Is it to science, in this latter sense, to philosophy, or to religion that the hegemony belongs?

In favor of science it may be said that it is the strongest bond of agreement in society. Scientific ideas are the only ones identical among individuals. Science must, then, 'take an ever-increasing part in the utilitarian and even moral direction of humanity' (p. 144). 'Science is nothing else than that social knowledge which is one of the essential elements of social consciousness' (p. 145).

But, though the idea of an 'organization by science' can merit only universal assent, the question remains whether the individual sci-

ences are sufficient to found the true 'cerebral unity' of the human race. Three hypotheses are possible. Either (1) religion and philosophy will be absorbed in the particular sciences, or (2) they will continue to coexist with science, but within more and more circumscribed spheres, or (3) they will grow with the growth of science itself.

Taking up arms for philosophy, Fouillée holds that, while it is manifest that the metaphysics which would explain the 'facts of experience by means of entities and of causes which cannot be verified by experience or established in a definite relation with it' ought to disappear (p. 147), yet the history of true metaphysics, from Plato to Hegel, shows no tendency to grow poorer. Not only so; but science is, and must be, theoretically and practically incomplete. Theoretically it abstracts (1) from a sentient and thinking subject, (2) from the whole of existence. Practically it abstracts from the moral aspect of the universe. Philosophy rests assured of a 'perennial function' in correcting the abstraction that has thus been made of the thinking subject, and in reëstablishing the unity of nature and of thought (p. 148). And, further, to it 'the intellectual hegemony in the practical order of things belongs,' 'because the rational basis of morality depends neither on the positive sciences nor on religious faith, but on philosophy itself' (p. 150). Science treats the world of organisms as machines; philosophy regards them as conscious, as animate. Science treats inanimate objects as phenomena, philosophy in animating them treats them as real (p. 151). Only for philosophy is a moral attitude possible (p. 152).

To the science, then, 'that is at once objective and subjective, with philosophy as its indispensable crown,' not to purely objective science, belongs the moral hegemony of humanity. There remains, however, a certain validity to sentiment, especially to religious sentiment. Not, indeed, to sentiment supposed to be a faith that increases our assurance without increasing our knowledge, but to sentiment that is the resultant of tendencies, for the most part inherited, unanalyzed and complex; but not for that reason unanalyzable (pp. 153–155). A 'good sentiment' is a collective reason instead of being reason in detail; but it is none the less reasonable for not having been reasoned out' (p. 155). Religion, while it may lose its mythology as metaphysics must lose its entities, may pass over into philosophy; but cannot be merged into the pure sciences with their objective methods. "Religion is a philosophy of sentiment and of imagination which is chiefly social, although it addresses itself to the individual; it is a poetry of consciousness, seeking after the loftiest universal ideal." (p. 160).

But while we grant a moral and intellectual hegemony to philosophy and science, it is not to these as contemplating dead facts and their relations, but to them as actions and productions. The question being *put* to nature is essential to its being *answered*. The result is a 'philosophy of action, in which thought is no longer merely a reflection and a copy of the model subjectively presented; but a creation of new effects in harmony with those already existing' (p. 104). Fouillée concludes, therefore, that 'the true hegemony belongs to the intelligent volition of universal ends, a volition which exists as obscure consciousness in religion, but reaches in philosophy and in science the clear consciousness of its goal and of its means' (p. 164).

Enough of the substance of Fouillée's article has been here given to convince the reader of its healthy tone and comprehensive view. Nothing could be freer from that paltry spirit of reconciliation that cannot rest until it has left the ghosts of philosophy, science and religion locked in an empty embrace in a vacuum that was once filled by the fruitful struggles of their substantial selves. And on the whole, despite some vaguenesses that naturally springs from the difficulty of putting a system of philosophy in a few words, one feels the justice of the author's conclusion. It is, for example, true that 'pure' science is content to rest upon certain abstractions, that religion misleads insofar as it separates certain emotions, as different in kind, from the rest of experience. But one may be inclined to question whether Fouillée has not mistaken an illegitimate abstraction of the scientist for the necessary, or at least convenient, abstraction of science. Must science abstract from the sentient and thinking subject? Must it abstract from the rest of the universe? Must it omit moral aspects? Are, in short, its 'phenomena' to be opposed to the 'realities' of philosophy? Science may, indeed, speak of an azoic age, may define sound as air vibrations, may employ the concept of 'l'homme machine.' But science may also ask what is the relation of the azoic age to the rest of experience, may also define sound as sensation, may also regard certain, or all, actions as meaningful. The azoic age, the sensation, the meaning, however, must be such as can be 'verified by experience or established in a definite relation with it.' To abstract from them, thus understood, is to set a limitation from considerations of economy, of division of labor. To include them is to bring in no new principles. That from which science does seek to abstract, is not the 'thinking' subject;' but the individual point of view—in short, illusion. Since to perform this abstraction is to consider only that which can find confirmation, the object of science is, in a true sense, the object of

a 'social consciousness.' The more accurate, the more complete the confirmation; the more perfect, the more 'objective' the science.

It is true that the scientist may seek to establish for his object a false independence from the rest of experience. He may rob it of all characteristics that make it an experience at all. But in so doing he sins against the intelligibility of his science itself. The philosopher, however, is in danger of committing the same sin if he would make the 'reality' of his object depend upon a 'meaning' which is not itself a phenomenon to be verified by and related to experience. Such an eject, based upon a false interpretation of analogy and of experience falls most naturally under the head of those very 'entities' and 'causes' for employing which Fouillée so justly condemns false metaphysics. The 'meaning' of actions, however, is a conception that has proved so difficult in the past, that one must rest in doubt as to whether one should accuse Fouillée of a fallacy, or oneself of a misunderstanding. Properly understanding them, however, science need not abstract from 'meanings.' If it does not, its separation from philosophy is merely a practical result of the economy of thought. Science rests, in its historical position, a less reflective philosophy, philosophy a more reflective science. Is philosophy destined to disappear in the growing reflectiveness of science? Perhaps, when there are no more reflections to be made. But then we shall be neither scientists nor philosophers; but in the happier sense of the word—sophists.

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NOTES.

A DICTIONARY OF PHILOSOPHY AND PSYCHOLOGY.

Macmillan & Co. have made arrangements for the issue in New York and London of a 'Dictionary of Philosophy and Psychology' under the editorial supervision of Professor Baldwin of Princeton University. The work is to have the following general features:

1. It will contain concise definitions of all the terms in use in the whole range of philosophical study (philosophy, metaphysics, psychology, ethics, logic, &c).

2. It will contain such historical matter under each term as may be necessary to justify the definition given and to show that the usage suggested is the outcome of the progress of philosophy, together with special historical articles.

3. It will have very full bibliographies both of philosophy generally and of the special topics which are connected with it.

With these features to give it character, and with the contributions of the leading men in this department of thought, chosen from England, America, and for the German and French usage, also from Germany and France, to give it authority, it is hoped that it may come to be a standard work, and serve two main purposes as follows:

First, It should, if successfully carried out, render to philosophy, in a measure, the service of 'setting' the terminology, in the different philosophical disciplines; and thus remove what is by common consent the greatest hindrance to their advance, *i. e.*, the varying and conflicting usages of terms which now prevail.

Such a book should serve both the teacher and the student in a most essential way. Teachers would have a consistent and, as far as the influence of the book might extend, uniform system of meanings with which to introduce these topics in the class room; and students would have the corresponding advantage of learning once for all an accepted terminology.

Second, It should serve as a general introduction to all the philosophical disciplines for all those who take interest in them.

Further, it is expected that men who are most competent in the several departments will contribute, and that in the result their work may present a fairly adequate statement of the present state of these studies in the world. All the matter in the Dictionary will be original and signed.

The following assignments of topics with the names of the authorities who will contribute original matter may be already announced:

General Philosophy and Metaphysics, Prof. Andrew Seth, Edinburgh University; Prof. John Dewey, Chicago University; *History of Philosophy*, Prof. Josiah Royce, Harvard University; *Logic*, Prof. R. Adamson, Glasgow University; *Ethics*, Prof. W. R. Sorley, Aberdeen University; *Psychology*, Prof. J. McK. Cattell, Columbia University; G. F. Stout, W. E. Johnson, Cambridge University; Prof. E. B. Titchener, Cornell University; The Editor, Princeton University; *Mental Pathology and Anthropology*, Prof. Joseph Jastrow, Wisconsin University; *Biology*, Prof. Lloyd Morgan, University College, Bristol; *Bibliography*, Dr. Benjamin Rand, Harvard University.

THE first number of *Kant Studien*, the new philosophical journal, edited by Dr. Hans Vaihinger, of the University of Halle, was published by Leopold Voss on April 25th. The number contains, in addition to an introduction by the editor, articles by Professors E. Adickes, K. Forländer, A. Sadtler and A. Pinloche, the last in French. Forty-three pages are devoted to reviews and 'Kantiana.'

THE American Association for the Advancement of Science meets this year at Buffalo, from August 23d to 29th. The anthropological section offers an opportunity for the reading of psychological papers, and the meeting is a favorable occasion to meet men of science working in allied departments.

DR. FRANZ BOAS has been appointed lecturer on physical anthropology in Columbia University.

DR. ARTHUR ALLIN, honorary fellow in psychology in Clark University, has been appointed to the professorship of psychology and pedagogy in the Ohio University at Athens.

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1. History of Ancient and Mediæval Philosophy, by Professor Fullerton.

2. Current Philosophical Literature, by Assistant Professor Newbold.

3. Psychology, by Assistant Professor Newbold.

4. Pathological Psychology, by Assistant Professor Newbold.

5. Analysis of Ethical Theories, by Assistant Professor Newbold.

6. History of Ethical Theories, by Assistant Professor Newbold.

7. Systematic Course of Experimental Psychology, by Assistant Professor Witmer.

8. Special Topics for Class Experimentation, by Assistant Professor Witmer.

9. Seminary for the Study of Child Psychology, by Assistant Professor Witmer.

10. The History of Education, by Professor Brumbaugh.

11. The Institutes of Education, by Professor Brumbaugh.

Philosophical, Psychological and Pedagogical Seminaries are held, in which the student is encouraged to prepare and read papers upon assigned subjects. Students of Philosophy and Ethics will find of value the courses offered in the University on Law and Jurisprudence, on Politics and Economics, and on the History of Religions. Students of Psychology will find open to them courses on Biology, Physiology, Mental Diseases, Nervous Diseases, and Medical Jurisprudence. Full information on these points may be had by consulting the University Catalogue.

For further information regarding the graduate courses enumerated above, application should be made to

DR. WILLIAM A. LAMBERTON,
Dean of the Department of Philosophy,
University of Pennsylvania,
PHILADELPHIA.